Acknowledgements

Each year, Riverine Plains Inc (RPI) brings you the Trials Book to keep you informed of the latest research being undertaken in the Riverine Plains. Because last year was a challenging one in terms of research, we've tried to provide a mix of articles which represents the range of issues we face as farmers in the Riverine Plains.

Although a large number of trials were established across the Riverine Plains last year, the dry spring meant that the results from most trials were severely affected by drought or frost. While this may have decreased yields and made interpretation of trends more difficult, the 2006 research reports still provide a great example of how we can take positive messages from all sorts of research work, even in the most extreme of years.

Most of last years trials were created by design, while some came about by accident or as a response to the dry season. But the two main things all of these trials had in common was that 1) someone had an idea for a trial and 2) that they found a spot of land where they could experiment and satisfy their thirst for that knowledge! So on behalf of RPI, I'd like to acknowledge all the people who came up with ideas for trials, no matter how big or small, and to all those farmers that donated land and their time (and often resources) to make these ideas a reality.

While many people contributed to this years edition of the trial book, special thanks need to be made to RPI consultants John Sykes, Tim Paramore, Peter Baines and John Seidel who do much of the design and legwork in setting up these experiments. Thank you also to the Universities of Sydney and Melbourne and research scientists from CSIRO for their ongoing collaboration.

DPI, on both sides of the river, contribute significantly to RPI and to this trial book. We appreciate greatly the support given to us by agronomists and researchers from both DPI Victoria and DPI NSW and especially those that provide executive support to the committee; Dale Grey, Lisa Castleman, Janet Wilkins, Rob Harris and Phil Newton.

We wish to thank the Grains Research & Development Corporation for their continued investment towards improving winter cropping systems in the Riverine Plains. It is exciting to see some of the results coming out of this project.

And finally, many thanks to Fiona Hart who collated all the articles and essentially put the book together.

We hope you find the information presented valuable and please feel free to make contact with any of the authors if you would like more information regarding any of the articles.

Wishing you the best of cropping season's in 2007.

Michelle Pardy
Editor

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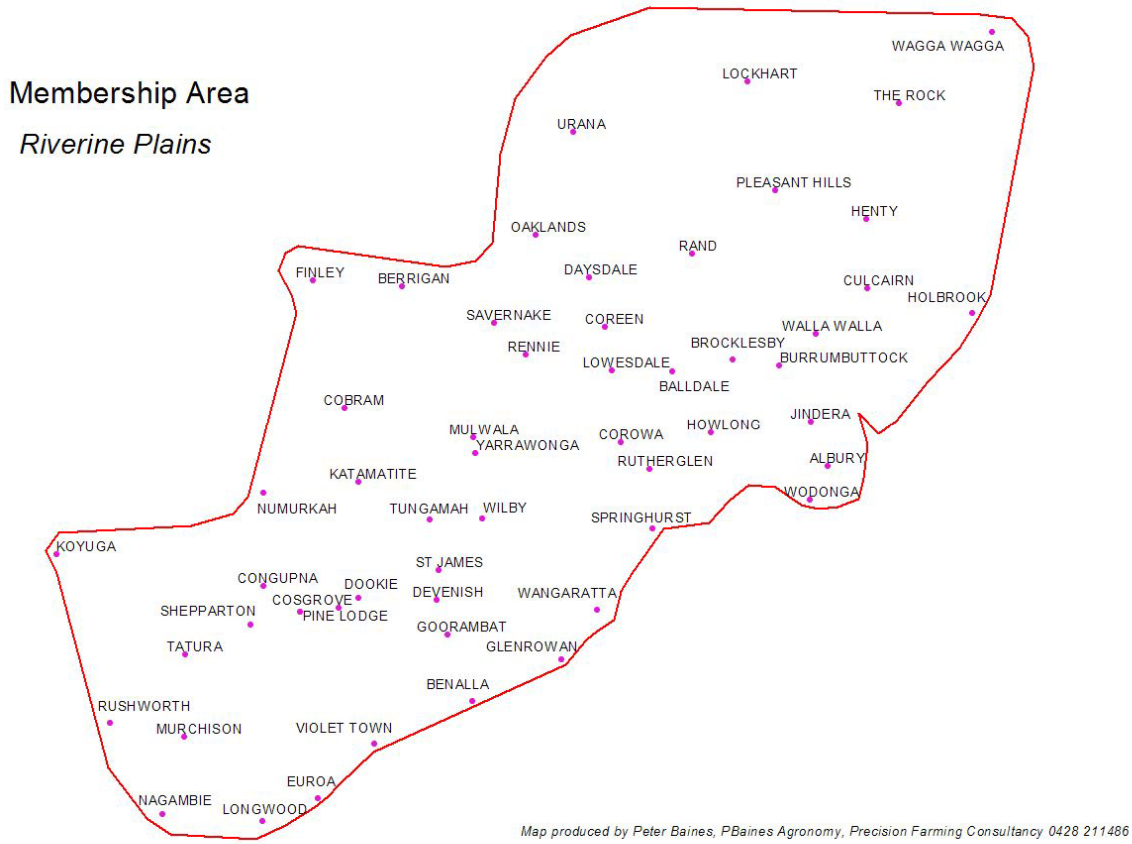
Area Covered by Riverine Plains Inc



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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 that 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 average 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 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 NS (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 be statistically validated. (For example, it may be that one variety was favoured by being sown on the better half of the paddock.) 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

In one respect, my time at UNE in the mid-nineties, seemed to coincide with a significant change in the rural landscape. While productivity in the grains industry was powering on, wool growers were in the middle of considerable restructuring and price depression, grains prices, with the exception of 95/96, were feeling the effects of a world trade war. Northern NSW was in the middle of a prolonged drought, while our own Riverine Plains area was struggling with wet winters. The general feel was that rural communities were really struggling.

For me, there was an acceptance that traditional community structure was dwindling. Rural populations were ageing, tennis and football teams were becoming harder to fill, community committees were still being run and worked by the same people that had done so twenty or thirty years ago. Also, with a renewed fiscal responsibility, government agencies, including agricultural bodies were being restructured, and funding was becoming harder to get for research and extension.

Now before we all get too down in the mouth it is important to recognize that people have been moving on and around rural towns and districts since colonial times. This has caused communities to appear and disappear, but in recent times, this trend has had a particular effect. For example, football and tennis teams have folded or merged, and some agricultural shows have shut down. The shows that continue have the same struggle to find new members.

In contrast to all this, and in spite of the continual challenges, the agricultural sector continued to move along. At my time at UNE for instance, it was their proud boast that all Rural Science graduates were fully employed within twelve months. The grains industry in particular, continued to forge ahead, with productivity improvements of around 3% p.a. Farmers were developing new skills in order to thrive, centering around marketing, broader business skills and human resources.

Perhaps it was a combination of all of the above that led, in the mid to late nineties, to the emergence of farming systems group like BCG, SFS, CWFS and of course Riverine Plains. In their own unique way, these groups were all responding to restructuring in agricultural communities, in order to fill gaps that had emerged, assist communities to survive and aid sustainability.

The year that has just been will go down as one of the worst droughts in history. Not just due to the lack of rainfall in 2006, but the drier than average last ten years that have devastated production in the drier areas of the country, and have diminished water reserves across the nation.

In our own area, financial losses have been significant, and the legacy of the drought will linger for some years as people recover. However, it is pleasing to report that Riverine Plains has continued to move ahead. Most importantly of all, you, our members have continued to find the time and energy to support what Riverine Plains continues to offer you in the form of services and events.

Members still found the energy to largely fill the bus trip north for a week last September. Enthusiasm was still apparent in the precision ag discussion group, and in the newly formed biological farming discussion group. One off days like the disc seeder day and the grains storage day were very well attended, as were the key seminar days.

Two events however stick in my mind from the last twelve months.

The 'Big Day Out - Forget the Drought' day was held last December, and the response to this day was amazing on series of different fronts. Firstly the support of the community for the day was almost overwhelming. Community organisations and businesses gave their time, goods and money to support local farmers in a way that could only buoy our spirits not only by their material gifts but by helping us all feel their support and compassion. Secondly the response of you and your neighbours in the form of your attendance and gratitude. With over 600 attending the day, it was easy to feel that the day was much needed and hence pleased that it was organized. Finally, the spirit on the actual day was very positive. In spite of the obvious and unavoidable hardship being caused by the drought, the willingness of you all to attend with you families and simply enjoy each other's company leading up to Christmas was very positive.

The annual February GRDC Farmer Update was held this year in Corowa with an attendance of 170. It set a record for Riverine Plains, and probably for all of the eastern states. Despite coming towards the end of such a tough time, other than a couple of technical issues, this day did not address the drought at all. It focused as usual, solely on productivity issues for the coming season. Such strong support for such an event at such a time shows that the future for Riverine Plains specifically, and agriculture in the Riverine Plains area generally is extremely positive indeed. Even in tough times there is a demand for good, objective data and advice to give the local industry the best chance of getting ahead, or in this case specially, getting back on its feet in the shortest time possible.

At the beginning of 2007, Hamish Sinclair decided to step down from the committee. Hamish was a key enthusiast and worker on the Riverine Plains committee since the group's inception. He always played important roles on the committee. Hamish was vice chair of the group from 2001-2007, played the vital role of liaising with private sponsors, and was just always there: organising, working on the ground, chairing conferences etc etc etc etc!!!! Hamish will be sorely missed on the committee for his hard work, his excellent counsel and simply his outstanding character. It is easy to forget the contribution that is made by people to community groups once they are out of the front line. I trust that we will all remember the contribution made by Hamish. We genuinely owe Hamish a debt of gratitude, and wish him the very best as his life moves forward.

In the last twelve months, Riverine Plains Inc has been supported as strongly as ever by our Fiona Hart, the New South Wales and Victorian DPI staff, the executive, the general committee, the sub committees, our sponsors and most importantly of all its members. I would like to thank you all for your support particularly this year, being such a difficult one. It's easy in tough times to lose enthusiasm, but the support for Riverine Plains has remained outstanding. Thank you once again. I look forward to what 2007 will hopefully bring you all.

Annual report for the Albury agronomy district - 2006

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 Meterology Silo Data.

Weather summary:
The summer of 2005-06 was dry, with very little rain in the first 3 months of the year. Despite some rainfall in April and early May, the season continued to be dry. From mid May though to June there was very little rain and no significant falls to allow crops to be sown. There was some rain in July and September, however with no significant rain in October, the hot, dry conditions resulted in a very quick end to the season.

2006 was one of the driest years on record for most areas of the district (Figures 3 and 4), with cumulative rainfall being just below the 10th percentile range (Figures 5 and 6) (or in the lowest 10% of all years). The dry conditions were experienced right across the region and caused poor growing conditions even in the more reliable eastern side of the district.

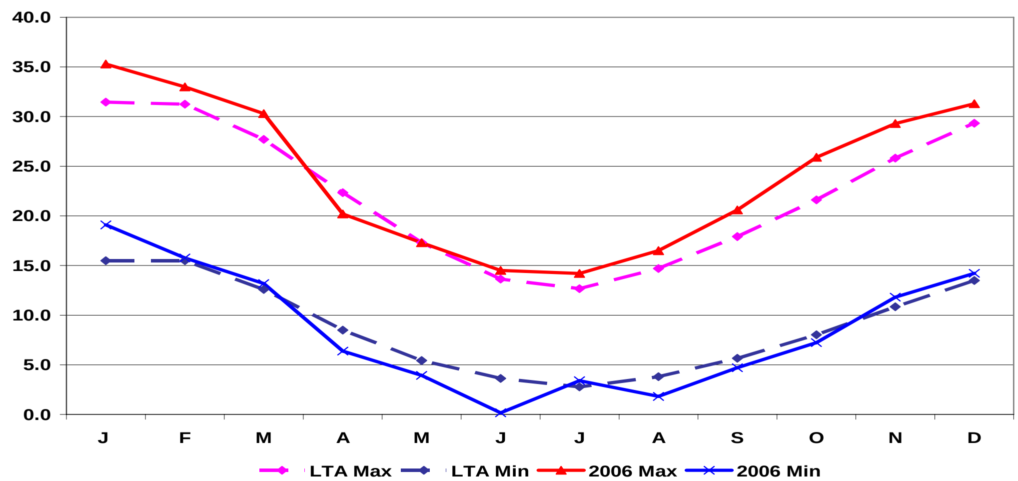


Figure 1. Minimum and maximum temperatures for 2006, compared to long term averages (LTA).

Monthly maximum temperatures were above average, particularly in the spring months (Figure 1). Winter minimum temperatures were well below average. This combined with the dry conditions resulted in an increased number of frosts (Figure 2).

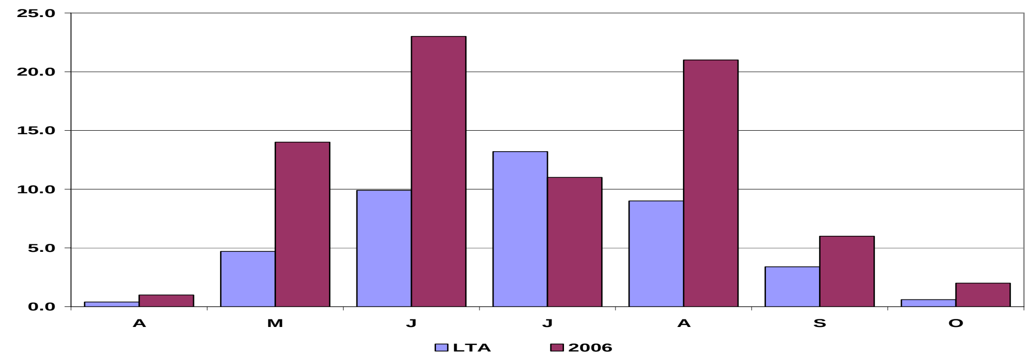
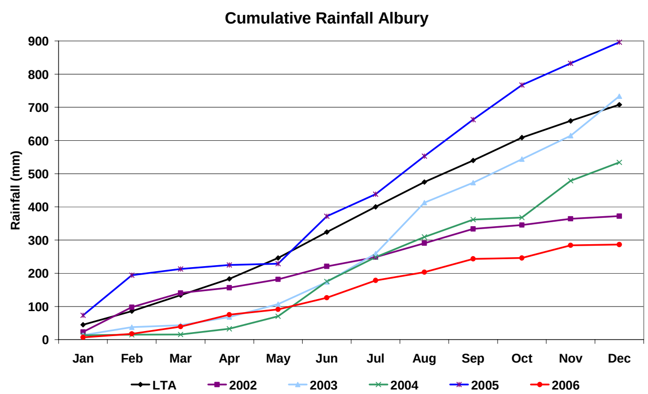


Figure 2. Monthly number of frosts for 2006 compared to LTA



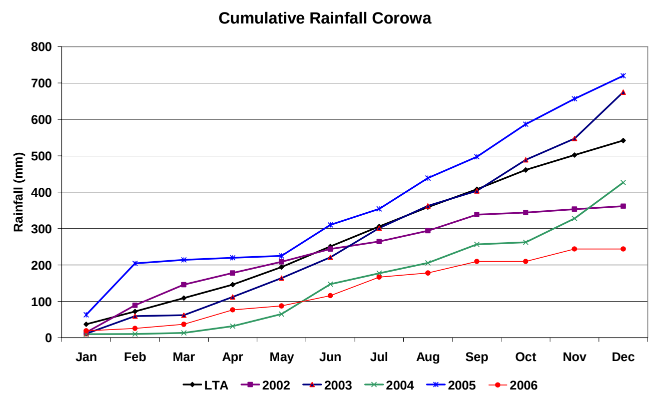
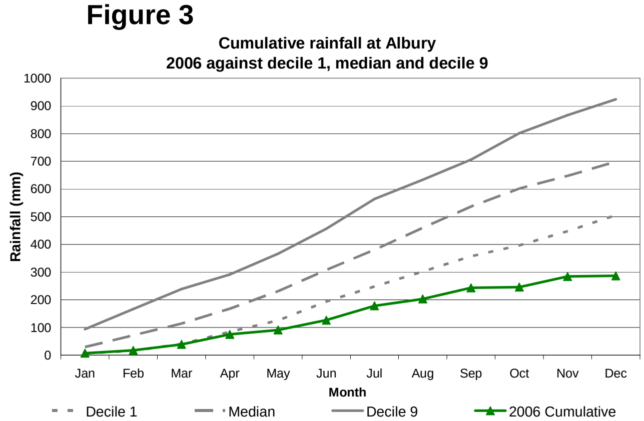


Figure 3

Figure 4



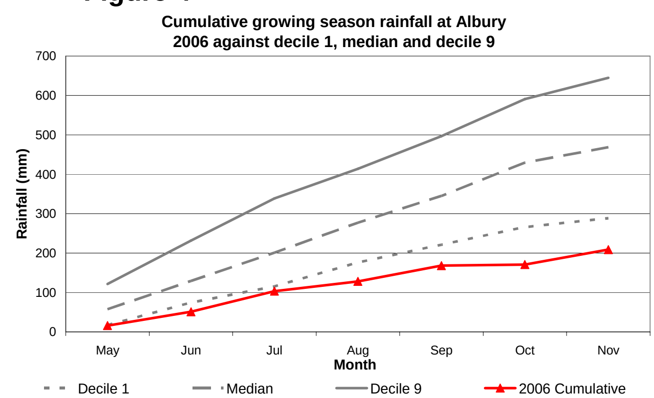
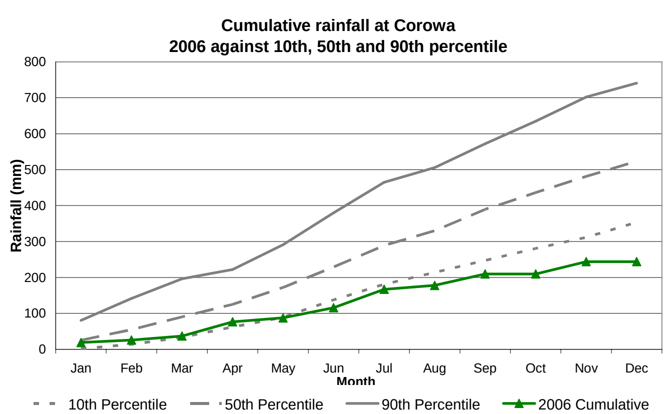


Figure 5

Figure 6



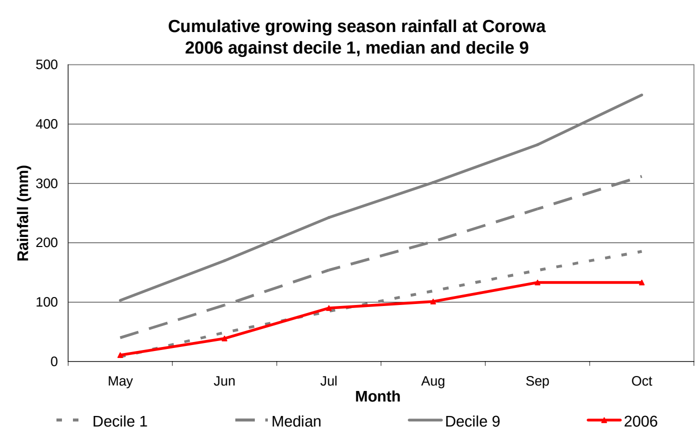


Figure 7

Figure 8

Cropping:
The first sowing opportunity came with some patchy April rain. Little or no subsoil moisture and a lack of follow-up rain restricted growth of these early sown cereal crops. Early crops sown on marginal moisture generally had patchy emergence, which resulted in uneven crops. This was particularly evident with many canola paddocks.

Many dry sown crops emerged on the first wide-spread rain in mid June. The heavy frost period in June and August, and the lack of moisture, combined to slow crop growth. The slow growth of grazing cereals reduced grazing periods, but grazing cereals still provided valuable forage when there was little other feed available.

Due to the lack of autumn rain there was little weed germination, or opportunities for weed control, before crop emergence. The increased area of dry sowing following two years of late breaks has increased weed seed burdens in many paddocks.

The late break and dry autumn and the lack of good follow-up rain, meant disease was not an issue in 2006. Very few crops had stripe rust and while a small number of paddocks were sprayed, the resulting yield meant that these sprays were not economical. Blackleg level in canola were low as was Sclerotinia in both canola and lupins.

Failed cereal crops, particularly on the eastern side of the district, were cut for hay where there was enough dry mater to make it worthwhile. With very little pasture growth and no pasture hay or silage, fodder conservation was important.

Yield of crops taken through to grain harvest was low, with the average wheat yield across the district being 0.5t/ha. Short season wheat varieties often yielded better than mid or long season varieties. Surprisingly, many grazed crops also yielded well due to the moisture conserved with grazing. Despite the dry season, grain quality was reasonably good. This was most probably due to the early dry conditions, which limited yield potential early on and allowed those set grains to fill grain properly.

Canola crops were severely affected by the frosts in September and October. This, combined with the moisture stress and insect pressure, meant most canola crops were cut for hay. Of the few canola crops taken through to harvest, yields were very disappointing with the average yield being 0.3 t/ha. Oil content was very low with frost damage and moisture stress contributing to oil contents for most crops of between 30 - 35%. Considering the relative value of hay and silage compared to grain, it was more economical to cut the crops for hay rather than retain for grain. Lupin crops were also frost affected with many paddocks yielding poorly, or not being harvested at all.

Pastures:
The dry summer and autumn resulted in little pasture growth. Clovers which germinated on April or May rain were slow growing, with frosty dry conditions limiting growth. Supplementary feeding continued late into autumn. Red legged earth mites contributed to the pasture stress.

Newly established perennial pastures and lucerne struggled to establish, with many dying out before summer and so will need to be re-sown. The lack of rain and hot temperatures in October meant most pastures had hayed off by the end of October.

Failed crops provided the only hay or silage available, however, the quality of these varied greatly depending on the time of cutting. Little November rain led to feed shortages by December with stubbles providing the only grazing. Low dam levels led to stock water issues and feeding of stock began early in the summer.

Victorian climate and weather patterns - 2006

Author: DeAnne Price

Contact No: 03 5362 2111

Organisation: DPI Victoria, Horsham

Following is a simple summary of climate and weather information released by the Bureau of Meteorology for Victoria during 2006.

Summer
Summer temperatures were well above normal, while rainfall was below average for most areas. Thunderstorm activity increased rainfall in central and north east Victoria. Weak La Nina conditions were evident during summer.

March
Warm northerly winds generated by high pressure systems over the Tasman Sea kept conditions dry and sunny.

April
Coldest April since 1995. A persistent cold trough line through central Australia helped generate a deep low system in mid April. Another low followed a week later which produced widespread rainfall.

May
Coldest May since 1970. A significant front early in the month brought rain to most areas. Blocking high pressure systems in the second half of May saw clear skies or high cloud that led to cool days, cold nights and recurrent frosts.

June
June was cold and dry. Victoria was dominated by slow-moving high pressure systems. Rainfall was the third lowest on record. Minimum temperatures were the second lowest on record (-2.13 degrees below average). The mean temperature for Victoria was the third lowest on record (-1.09 below average).

July
A number of cold fronts and low pressure systems passed over Victoria during July (5 fronts and low pressure systems). A low pressure system in the middle of the month brought some rain to most areas. Mean temperatures were mostly near normal.

August
Driest August since 1982 and fifth driest on record. Mild days, cold nights and very dry conditions persisted in August. High pressure systems dominated pressure patterns during August. Clear skies made for milder than usual days and cold nights. A strong high over the Tasman Sea during the last week of the month directed unusually warm air to flow over the State from the north.

September

The dry weather was a consequence of two major features of the global sea surface temperature distribution. The current Pacific sea surface temperature distribution was typical for the development phase of an El Niño event. Key indicators included sea-surface temperatures above El Niño thresholds, sustained negative values of the Southern Oscillation Index (SOI), and weaker than average Trade Winds during the previous two months (reducing the amount of moisture being brought towards Australia). Sea surface temperatures over Indonesian waters were very low, preventing the formation of cloud bearing jet streams ahead of cold fronts.

Very dry air across south-eastern Australia resulted in the State experiencing clear skies, well above average daytime temperatures, with some record highs. Radiational cooling during the night caused below average night temperatures, and a number of severe frosts. Fronts moved rapidly across the southern ocean, generating some particularly windy periods, but little rain.

October

Warm days, cold nights and dry conditions continued in October. Early October saw a 35 degree day, while snow was also recorded in the month.

It was the warmest October on record for Victorian maximum temperatures since records began in 1950 and the second coolest for mean minimum temperatures. October rainfall was the lowest since 1914 and the second driest October ever recorded.

There were a number of cold frontal passages. In a typical October, each of these frontal passages might have been expected to drop about 10−20 mm of rain. However, these fronts resulted in 1 mm or less of rain.

The cause for the extreme weather conditions was the El Niño event combined with unusually cold water over northern Australian/Indonesian waters. This combination led to the sinking and drying of air over Australia, resulting in clear skies, hot days and cold nights.

November

November saw temperature fluctuations and dry conditions, with slightly cooler than normal nights and warmer days. Snow fell to low levels on November 15th. Forty degree days occurred on the 21st and 22nd in the north.

High pressure systems regularly moved from far south of Western Australia (with very cold surges around their eastern flanks resulting in cold weather over Victoria), to the ENE towards the Tasman Sea. Once over the Tasman Sea, the highs drove hot air from over the inland across Victoria.

December

Dry conditions continued. High pressure systems dominated the weather, producing northerly winds when situated over the Tasman Sea. A cold air mass moving up from the south on the 24th produced cold conditions for the Christmas period and snow was reported in some regions of the state.

Insert full page CASE IH ad here as follows:

½ page for WM Johnson Ad
½ page O'Connors Ad

Triticale maximum yield experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 232 mm
GSR: 166 mm
Soil:
Type: Red Chromosol
pH (H_20): 4.9
P (Colwell): 42 mg/kg
Deep Soil N: 82 kg/ha
Sowing Information:
Sowing date: 28/6/2006
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 message:
- Triticale does not significantly respond to N, or fungicide in dry years.

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. The variety sown was Kosciuszko.

Results:

Table 2: Summary of Yield (t/ha) and Gross Margin (whole $/ha) results for Triticale

Treatment Description	Yield (t/ha)	Gross Margin ($/ha)
0 N[1]	0.67	66
20 N[1]	0.85	96
40 N[1]	0.97	148
60 N[1]	0.89	69
80 N[1]	0.79	21
100 N[1]	0.65	-41
120 N[1]	0.42	-128
Fungicide[2] 0 N	0.69	64
Fungicide[2] 20 N	0.94	117
Fungicide[2] 40 N	1.05	164
Fungicide[2] 60 N	0.72	13
Fungicide[2] 80 N	0.60	-41
Fungicide[2] 100 N	0.50	-92
Fungicide[2] 120 N	0.41	-135
LSD (0.05)	0.23	84

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

Observations and comments:
- Addition of 40 kg/ha of N significantly increased the yield of triticale.
- Addition of fungicide did not significantly increased yield.
- The most economic treatment (gross margin) was 40 kg/ha of N with or without fungicide.

Sponsors:
The Grains Research & Development Corporation, Mr C Cay, Mrs S Cay.

Barley maximum yield experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 232 mm
GSR: 166 mm
Soil:
Type: Red Chromosol
pH (H_20): 4.9
P (Colwell): 42 mg/kg
Deep Soil N: 82 kg/ha
Sowing Information:
Sowing date: 28/6/2006
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:
- Barley responded to inputs of nitrogen, but responded variably to fungicide in 2006.
- 20-40 kg/ha of N was required to maximise yield.
- Where there was a N response, fungicide gave an additional yield response.

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. Baudin was the variety sown.

Results:

Table 3: Summary of 2006 Yield (t/ha), Protein (%), Screening and Retention (%) and Gross Margin ($/ha)

Treatment	Yield (t/ha)	Protein (%)	Retention (%)	GM ($/ha)
Nil 0N	0.8	12.40	94	168
Nil 20N[1]	1.0	12.20	91	232
Nil 40N[1]	1.3	12.80	76	283
Nil 60 N[1]	1.2	16.80	61	243
Nil 80N[1]	1.1	17.20	55	203
Nil 100N[1]	1.1	16.40	42	175
Nil 120N[1]	1.0	15.60	53	125
SD, Z31 + Z39[2] 0 N	0.8	12.60	96	160
SD, Z31 + Z39[2] 20 N	1.4	12.80	91	322
SD, Z31+ Z39[2] 40 N	1.5	11.40	83	350
SD, Z31+ Z39[2] 60 N	1.3	14.60	72	279
SD, Z31+ Z39[2] 80 N	1.3	15.20	68	234
SD, Z31+ Z39[2] 100 N	0.8	16.20	61	82
SD, Z31+ Z39[2] 120 N	1.1	16.70	55	139
SD, Z31[3] 40 N	1.5	12.90	76	351
SD, Z39[3] 40 N	1.2	12.60	73	254
SD, Z45[3] 40 N	1.2	12.40	81	207
SD, Z31[3] 80 N	1.2	16.80	61	226
SD, Z39[3] 80 N	1.0	15.70	66	173
SD, Z45[3] 80 N	1.0	14.90	67	145
SD, FolZ31 80 N	1.5	14.60	68	286
SD, FolZ31+ Z39, 40N	1.5	12.30	74	329
SD, FolZ31+ FolZ39, 80N	1.3	15.40	64	241
SD, FolZ39, 80N	1.1	16.30	68	164
SD, OpusZ31+ Z39, 40N	1.6	12.40	77	334
SD, OpusZ31+ OpusZ39, 80N	1.3	16.40	63	206
SD, OpusZ39, 80N	1.1	14.90	71	166
SD, OpusZ31, 80N	1.3	15.20	66	243
LSD (0.05)	0.24	1.20	12	

1 – Rate of post emergent N applied at Z15. 2 – Two applications of 500 ml/ha of 125 g/L Triadimefon fungicide at Z30 and Z39.
3 – One application of 1 L/ha of 125 g/L Triadimefon fungicide at Z30, Z39 or Z45.
SD – Seed Dressing as 1.5L/t of Baytan. Fol – Folicur. Z – Zadock growth stage.

Observations and comments:

- N increased the yield to 40 kg/ha then yield decreased with additional applications.
- Fungicides did not increase yield in the absence of additional N. Then the response was relatively uniform to 40 kg/ha of N at 15%. Above 40 kg/ha of N there was no response to either N or fungicide.
- Not adding N resulted in the best protein and retention for the production of malting barley. 40 kg/ha resulted in protein that was too high for malting.
- Single application of fungicide at about Z31 gave the best results.
- Using 40 kg/ha of N and one fungicide spray by ground gave the highest gross margin.
- A preliminary extension program for improved growing barley was used by 10 farmers but no results were obtained, as N or fungicide was not used by the farmers. It will be run again in 2007.

Sponsors:

The Grains Research & Development Corporation, Mr C Cay, Mrs S Cay.

Wheat maximum yield experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 232 mm
GSR: 166 mm
Soil:
Type: Red Chromosol
pH (H_20): 4.9
P (Colwell): 42 mg/kg
Deep Soil N: 82 kg/ha
Sowing Information:
Sowing date: 28/6/2006
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:
- In dry years wheat has only a little response to extra inputs.
- Avoid using unnecessary inputs early to maximise income.

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 4: Summary of Yield (t/ha), Protein (%) and Screening (%) and Gross Margin ($/ha over 0N) results

Treatment Description	Mean	Protein (%)	Screenings (%)	Gross Margin ($/ha)
P20, 0 N	0.66	13.20	1.7	53
P20, 20 N	0.84	14.60	2.6	87
P20, 40 N	0.91	15.40	4.1	86
P20, 60N	0.85	17.20	6.4	48
P20, 80 N	0.79	16.80	7.8	10
P20, 100N	0.59	17.90	8.2	-70
P20, 120N	0.50	17.30	8.6	-117
P20, 0 N, Fungicide[1]	0.94	12.60	1.0	129
P20, 20 N, Fungicide[1]	1.20	14.20	1.6	188
P20, 40 N, Fungicide[1]	1.22	15.80	4.6	176
P20, 60N, Fungicide[1]	0.94	17.40	4.6	71
P20, 80 N, Fungicide[1]	0.71	17.20	6.1	-17
P20, 100N, Fungicide[1]	0.68	17.00	7.4	-48
P20, 120N, Fungicide[1]	0.47	17.40	7.9	-131
P20 80N, Fungicide[2] Z31	0.79	16.80	6.2	11
P20, 80N, Fungicide[2] Z39	0.78	17.60	7.3	7
P20, 80N, Fungicide[2] Z45	0.69	17.40	6.8	-19
P25, 80N, Fungicide[1]	0.80	16.80	5.4	0
P25, 120N, Fungicide[1]	0.80	17.50	8.2	-42
P30, 80N, Fungicide[1]	0.74	16.90	6.7	-25
P40, 80N, Fungicide[1]	0.71	17.60	6.3	-63
LSD (0.05)	0.53			76

1 – Fungicide - Two applications of 500 ml/ha of 125 g/L Triadimefon at growth stages Z30 and Z39.
2 – Fungicide Z31 (or other as indicated) One application of 500 ml/ha of 125 g/L Triadimefon at that growth stage. All seed treated with Jockey seed dressing. Protein and screenings on composite sample only. Gross Margin (whole $/ha) based on $300 /t (delivered local silo) and N @ $0.98 /kg delivered, fungicide @ $6.25 /ha/application for ground application and $15.50 /ha for aerial application.
P – Phosphorus at rate indicated. N – Nitrogen at rate indicated. Z – Zadock growth stage.

Observations and comments:

- Addition of 20 and 40 kg/ha of N and a fungicide treatment resulted in a significant increase in yield and gross margin compared to the zero N treatment only.
- No other treatments show a significant response to yield or gross margin above no added input and many had significantly negative responses.
- Addition of fungicide did not increase yield except in combination with low rates of N fertilizer.
- Protein and screenings were not adversely affected until over 40 kg/ha of N was applied.

Sponsors:

The Grains Research & Development Corporation, Mr C Cay, Mrs S Cay.

Wheat fungicide experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 232 mm
GSR: 166 mm
Soil:
Type: Red Chromosol
pH (H_20): 4.9
P (Colwell): 42 mg/kg
Deep Soil N: 82 kg/ha
Sowing Information:
Sowing date: 28/6/2006
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 fertilizer dressings and in-crop fungicides did not give a response in wheat in a drought year.
- Ventura and H45 yielded better than Diamondbird in 2006.

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

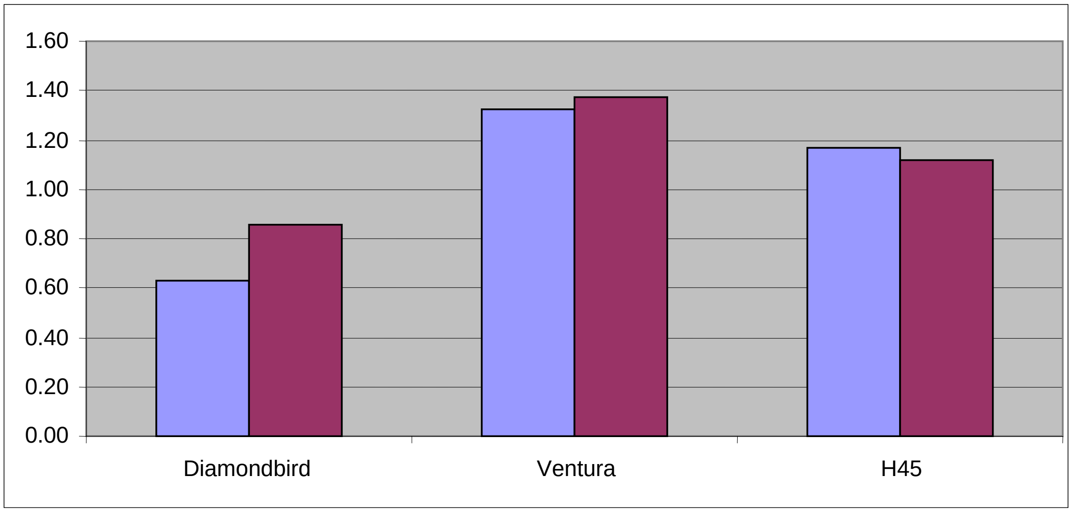
Method:
A replicated experiment was established comparing different fungicides and seed or fertilizer dressings for their ability to control Stripe Rust on a number of varieties.

Results:

Table 5: Summary of Yield (t/ha) and Gross Margin ($/ha over 0N) results

Treatment	Yield (t/ha)	Gross Margin ($/ha over 0N)
Nil Seed Treatment, Nil Fungicide	0.63	70
Nil Seed Treatment, Fungicide[1] Z31	0.67	75
Nil Seed Treatment, Fungicide[1] Z31 + Z39	0.63	25
Nil Seed Treatment, Fungicide[1] Z39	0.79	110
Nil Seed Treatment, Fungicide[1] Z45	0.78	96
Jockey, Nil Fungicide	0.61	57
Jockey, Fungicide[1] Z31	0.79	100
Jockey, Fungicide[1] Z31+Z39	0.83	99
Jockey, Fungicide[1] Z39	0.79	102
Jockey, Fungicide[1] Z45	0.77	88
Impact, Nil Fungicide	0.80	101
Impact, Fungicide[1] Z31	0.75	84
Impact, Fungicide[1] Z31 + Z39	0.68	48
Impact, Fungicide[1] Z39	0.81	100
Impact, Fungicide[1] Z45	0.80	85
Impact(1.5)[2], Nil Fungicide	0.86	111
Impact(1.5)[2], Fungicide[1] Z31+Z39	0.64	30
Impact(1.5) [2], Fungicide[1] Z39	0.79	93
Triad, Nil Fungicide	0.64	73
Triad, Fungicide[1] Z31	0.73	93
Triad, Fungicide[1] Z31 + Z39	0.79	97
Triad, Fungicide[1] Z39	0.84	126
Triad, Fungicide[1] Z45	0.73	84
H45, Nil Fungicide	1.17	226
H45, Fungicide[1] Z31+Z39	1.12	190
Ventura, Nil Fungicide	1.33	269
Ventura, Fungicide[1] Z31+Z39	1.37	272
LSD (0.05)	0.29	

1 – In crop application of Triadimefon applied at growth stage indicated. 2 – Impact applied at 1.5 x recommended rate. Variety is Diamondbird unless otherwise stated. Z – Zadock growth stage.



Blue hatched bar – No added fungicide. Red bar – With Triadimefon fungicide sprays at Z31 and Z39.

Figure 9. Variety Yield (t/ha) Comparison

Observations and comments:

- Fungicides gave little response in the drought conditions of 2006.
- The best yields were achieved by the varieties H45 and Ventura, which both yielded significantly more (60-75%) than Diamondbird.
- Ventura had the best Gross Margin, averaging about $150-180 /ha above Diamondbird.
- Protein and grain quality (not reported) was good (high protein and low screenings) and not significantly affected by applications of fungicide.

Sponsors:

The Grains Research & Development Corporation, Mr C Cay, Mrs S 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: 232 mm
GSR: 166 mm
Soil:
Type: Red Chromosol
pH (H_20): 4.9
P (Colwell): 42 mg/kg
Deep Soil N: 82 kg/ha
Sowing Information:
Sowing date: 28/6/2005
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:

- Wheat on wheat following canola is an alternative that will enable more cereal crop to be grown in a rotation.
- Under dry conditions there were no responses to additional nitrogen or fungicide treatments except in barley.
- 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 was the best crop to grow at this point in the rotation.

Method:
A replicated experiment was established using similar treatments to 2004 and 2005.

Results:

Table 6: Yield (t/ha) and return (Gross Margin or GM in $/ha) of the 2006 crop comparison experiment

Crop	40N		80N		40N+Fungicide		80N+Fungicide	
	Yield (t/ha)	GM ($/ha)	Yield (t/ha)	GM ($/ha)	Yield (t/ha)	GM ($/ha)	Yield (t/ha)	GM ($/ha)
Wheat	1.0	59	0.8	-17	0.8	3	0.7	-67
Triticale	0.9	58	0.9	10	0.9	41	0.6	-97
Barley	1.1	84	1.1	52	1.5	163	1.3	73
Canola	0.2	-154	0.1	-199	0.2	-182	0.2	-224
Lupins	0.2	-104						
Yield LSD (P<0.05) 0.24 t/ha								

Table 7: 2004/06 Average yield (t/ha) and return (Gross Margin or GM in $/ha) of the crop comparison experiment

Crop	Farmer[1]		Nitrogen[2]		Nitrogen+Fungicide[3]	
	Yield (t/ha)	GM ($/ha)	Yield (t/ha)	GM ($/ha)	Yield (t/ha)	GM ($/ha)
Wheat	1.9	157	2.6	262	3.0	319
Triticale	1.9	148	3.3	374	3.4	373
Barley	1.7	92	2.8	268	3.1	295
Canola*	0.8	48	1.3	202	1.2	87
Lupins*	0.7	47				
Yield LSD (P<0.05) 0.31 t/ha						

1- Normal Farm management. P applied at 20 kg/ha, N at 53 kg/ha including 40 kg/ha post emergent.
2- Management as for 1 but 80 kg/ha of N applied post emergent.
3 – As for 2 plus 2 x 1 l/ha applications of 125 g/L Triadimefon fungicide applied at Z32 and Z39 for disease control.
*- Only included in 2005 and 2006.

Observations and comments:

- Addition of N and the use of fungicide did not significantly increase the yield of wheat and triticale in 2006.
- Addition of N and the use of fungicide significantly increased the yield of barley in 2006.
- In the longer term (Table 7) the application of N and the use of fungicide produced a yield rise in wheat, barley and triticale and produced an economic return.
- Canola and lupins yielded poorly in 2006 with negative gross margins becoming more negative as inputs were applied.
- Longer term canola has responded positively to N applications but not to fungicide.

Sponsors:
The Grains Research & Development Corporation, Mr C Cay, Mrs S Cay.

Fluid P comparison experiment

Author: Compiled by John Sykes from information supplied by Mark Conyers, NSW DPI

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting/NSW DPI

Location: Yarrawonga
Growing Season Rainfall:
Annual: 264 mm
GSR: 167 mm
Soil:
Type: Brown Sodosol
pH ($H_2$0): 5.2
P (Colwell): 35 mg/kg
Deep Soil N: kg/ha
Sowing Information:
Sowing date: 23/6/2006
Row Spacing: 180 mm
Paddock History:
2006 – Peas
2005 – Pasture
2004 – Pasture
Plot Size: 1.5 m x 16 m
Replicates: 4

Key messages:

- The forms of phosphate (P) fertilizer do not make a difference to yield in the soils in the Riverine Plains area.
- Fluid P does not give a better response than solid P.
- As fluid P is more expensive than solid P, solid P would be preferred to fluid forms in this area.

Aim:
To assess whether fluid forms of P give a better response or more economic response than solid forms of P in wheat.

Method:
A series of replicated experiment were established using differing rates of P and constant N and were conducted at Temora, Culcairn, Balranald and Yarrawonga. The products being evaluated were solid MAP, TGMAP (a soluble form of MAP), phosphoric acid and EZY NP. The rates of application were 10, 20 and 30 kg P/ha. The N contents of each fertiliser were balanced with urea to provide a total N application rate of 60 kg/ha.

Results:
As the season dried out, higher yield potentials were not realised. Grain at the Temora site responded negatively to applied P (Figure 10) while the Culcairn, Yarrawonga and Balranald sites showed a positive response to P, at least to 20 kg P/ha.

There was no difference in yield between solid and fluid forms of P at the Temora, Culcairn or Yarrawonga trial sites (data not presented). However, preliminary analyses on the Balranald site indicates that there was a difference between the solid and fluid products. For the first and second cuts the TGMAP gave higher dry matter and P uptake than the other treatments, but this did not carry forward into grain yield during the dry spring. It remains open then, that the alkaline and calcareous mallee soils found in south western NSW might respond positively to fluid P in the same way as the those soil types do in South Australia and western Victoria.

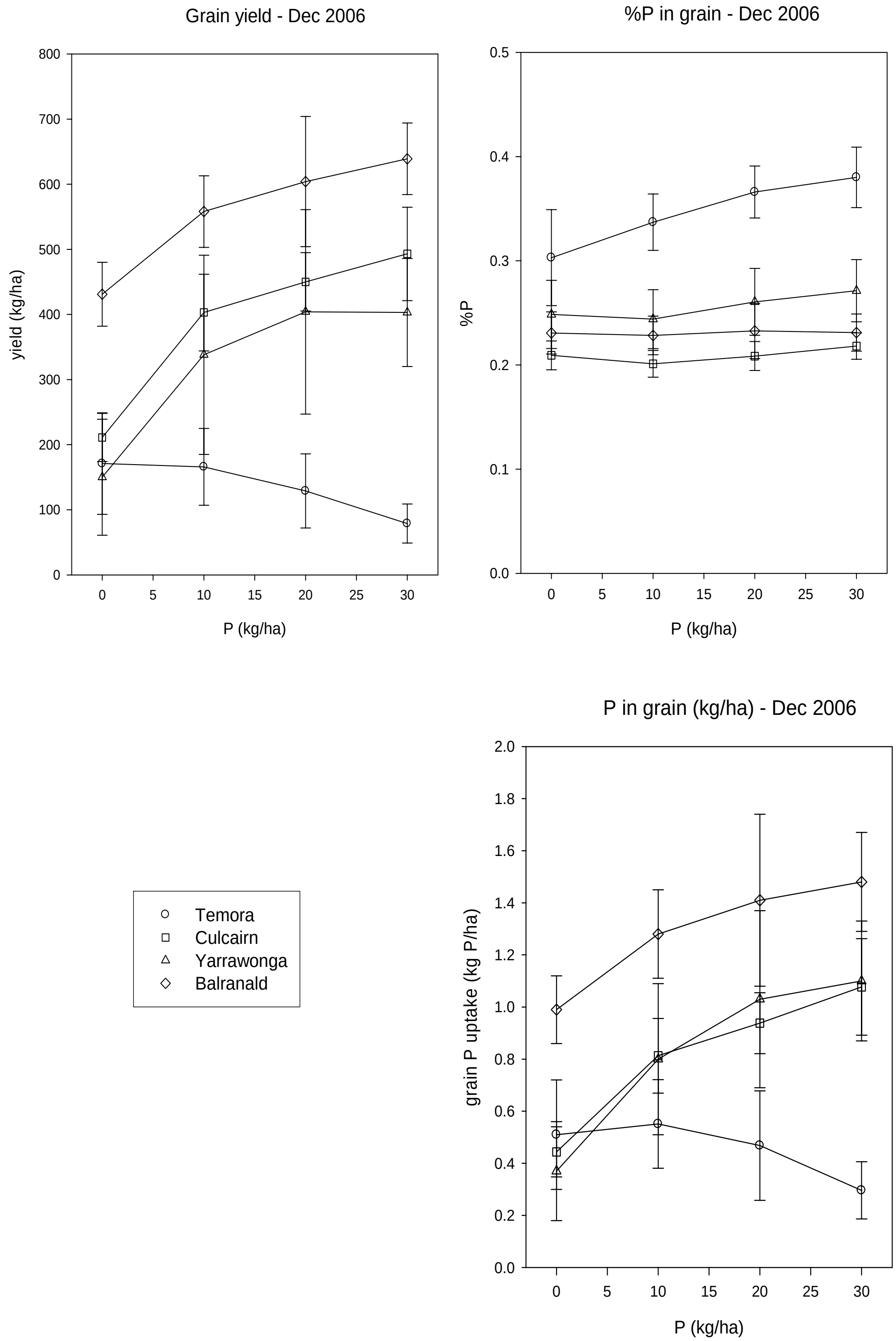


Figure 10. Grain Yield (t/ha) and P Removal (kg/ha) from the Fluid P Experiments Conducted in 2006 in Southern NSW and North East Victoria

Observations and comments:

- Addition of P gave a positive response in both yield and dry matter in wheat.
- The products all gave similar responses to each other on soil types found in the Riverine Plains.

Sponsors:

The Grains Research & Development Corporation and Mr P White.

Beneficial invertebrates in field crops

Author: Joanne Holloway

Contact No: 02 6938 1605

Organisation: NSW DPI

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 (Vic) 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 from the first two surveys have been separated into reference ‘morphospecies’ that will be identified to species level once the last sample has been completely sorted. 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 condition. This may affect the number and type of invertebrates collected.

Diversity in the number of species was greater prior to sowing than during the establishment phase, with 153 species types recognised from the March sample compared to 90 in July. The main groups represented in both surveys were Hymenoptera (ants and wasps), Diptera (flies) and Coleoptera (beetles). The main beneficial invertebrate species found were parasitic wasps, spiders, predatory beetles, and lacewings.

While species diversity was found to be lower in July, the actual number of individuals collected was much greater (6129 individuals in July compared to 3756 in March). This was primarily due to large numbers of fungus gnats (Diptera: *Bradysia* spp) and lucerne flea (Collembola: *Sminthurus viridis*) found in almost every paddock, and a high infestation of aphids from a vacuum sample in one lucerne paddock. All three of these species can cause damage to crops, though it is generally the larval stage of the fungus gnat that does the damage and none of these were collected. In most other species, the number of individuals collected was actually lower in July.

Although it has yet to be fully analysed, one crop management process that appears to affect the number of beneficial species present is stubble retention. However, as stubble retention increased the numbers of all species, both beneficial and pest species benefit from this practice. Only one of the paddocks surveyed was burnt prior to sowing. While burning initially reduced the numbers of species and individuals present in the pre-sowing survey, these results did not appear to persist through to the survey taken during crop establishment.

Observations and comments:
The invertebrate community in field crops is diverse, with most species having no effect on the crops. Beneficial species may only be a small component of this community, but they are a primary component of any IPM strategy. Any management practices that are useful in building up their numbers need to be investigated.

The most common beneficial invertebrates found in crops throughout the Riverine Plains were parasitic wasps, spiders, predatory beetles 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. With further research and analysis, it should 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 in developing an IPM strategy for field crops.

Sponsors:
NSW Department of Primary Industries and the Grains Research & Development Corporation.

Biological farming discussion group

Author: Cathy Botta

Contact No: 03 5762 7193

Organisation: Consultant

Key messages:
- Biological farming systems adopt practices that increase soil biological activity and diversity.
- Biological farming systems can expect to have similar yields to conventional systems.
- Biological farming takes a paradigm shift in thinking about agriculture and takes a longer term view.

Aims:
- To explore biological farming systems starting from the basics including – what is a biological farming system?
- To explore different approaches farmers have used to develop a biological farming system.
- To provide an opportunity for farmers to share their experiences, and learn from each other.

Method:
Sharing experiences in group discussion, speakers, and visiting farmers who have had a go at developing biological farming systems

Results:
1. What is biological farming?
    - Adopting inputs/practices that increase soil biological activity and diversity.
    - Adopting sustainable systems that reduce reliance on artificial inputs.
    - Farming systems that are carbon based.

2. Key principles and practices in a biological farming system:
    - Lime application each year.
    - Organic matter is very important so stubble retention and/or incorporation is a key practice.
    - Use of soil biology stimulants/feeders.
    - Relies on interactions with nutrients and soil biology.

Observations and comments from experiences with biological farming:
- Biological farming systems can expect to have similar yields to conventional systems.
- Some biological farming systems can have larger costs in the initial years until the system is established.
- Biological farming systems are flexible and can include a range of ‘conventional’ practices.

Sponsors:
DPI Victoria and Riverine Plains Inc.

Biological seed treatments in wheat

Author: John Seidel

Contact No: 0429 039 322

Organisation: Peracto Pty Ltd

Location: Balldale
Growing Season Rainfall:
Annual: 232 mm
GSR: 166 mm
Soil:
Type: Red Chromosol
pH (H_2O): 4.9
P (Colwell): 42 mg/kg
Deep Soil N: 82 kg/ha
Sowing Information:
Sowing date: 28/6/2006
Fertiliser: 90 kg/ha MAP
Row Spacing: 180 mm
Paddock History:
2006 – Wheat
2005 – Wheat
2004 – Canola
Plot Size: 1 m x 11 m
Replicates: 4

Key messages:

- Dry seasonal conditions may have influenced the performance of biological products in 2006.
- The biological seed treatments in combination with natural fertilizer provided less vegetative growth early in the season compared to the conventional fertilizer program.
- The conventional fertilizer program tended to provide higher yields compared to the biological program.

Aim:
To compare biological seed treatments and fertilizers with a conventional fertilizer program in wheat.

Method:
Biological seed treatments claim to improve the capability of plants to access and utilize nutrients from the soil. The biological seed treatments were applied with a natural fertilizer, Guano (organic fertilizer with 12% P, 29% Ca, 10% Si and trace elements) and 5% boron humate granules, as the basal fertilizer at 140 kg/ha. This was compared to the conventional double superphosphate (Sulfos) used as the basal fertilizer at 70 and 140 kg/ha. Urea was topdressed at 1st node stage to selected treatments. The trial was a randomised complete block design with four replications. Phosphorous and nitrogen were applied in different combinations to determine which macro-nutrients would provide the major response at this site.

Table 8: Treatment List

No.	System	At Sowing		After Sowing
		Seed Treatment	**Basal Fertilizer**	**Nitrogen (urea)**
1.	Control A	Nil	Nil	Nil
2.	Control B	Nil	Double super 22 P	Nil
3.	Control C	Nil	Nil	57 units N
4.	Standard A	Premis	Double super 22 P	57 units N
5	Standard B	Premis	Double super 11 P	57 units N
6.	Impact	Premis	Double super 22 P + Impact	57 units N
7.	Biological ST	Biomix Seed Coat	Guano	57 units N
8.	VAM Dressing	BioVAM	Guano	57 units N
9.	VAM Dressing	BioVAM	½ rate Guano	57 units N
10.	New Edge Free-living N	PSK	Guano	Nil
11.	HybridAgric Free-living N	EcoN	Guano	Nil
12.	P Solubiliser	PS30	Guano	57 units N

Treatment legend:
Biomix Seed coat – used to try to enhance microbial activity in the soil
PSK and EcoN – free living N fixers
PS30 – P solubiliser and plant growth promoter
BioVAM – enhances P uptake in roots

Results:
All treatments provided satisfactory emergence and establishment of the wheat plant population.

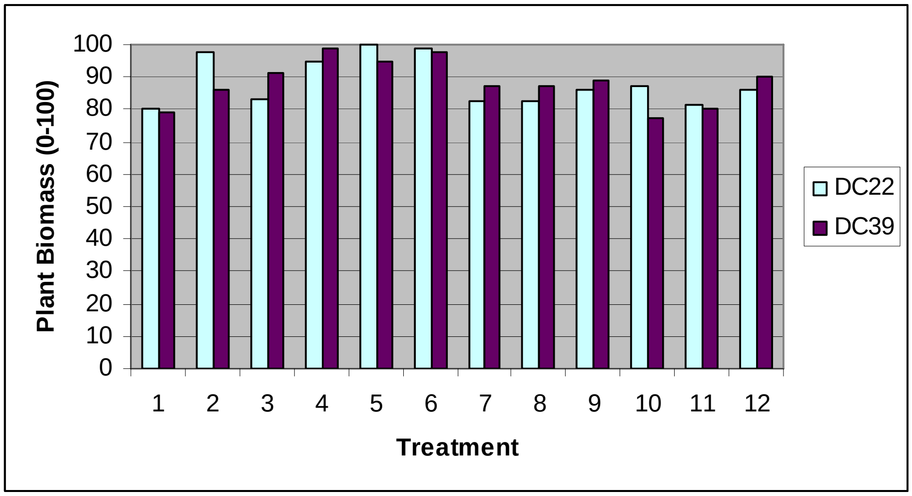


Figure 11. Plant biomass at 3 tiller (DC22) and flag leaf emergence (DC39)

The conventional system (Treatments 2, 4, 5 & 6) provided greater green matter production during the early to mid season period compared to the biological system (Treatments 7 to 12).

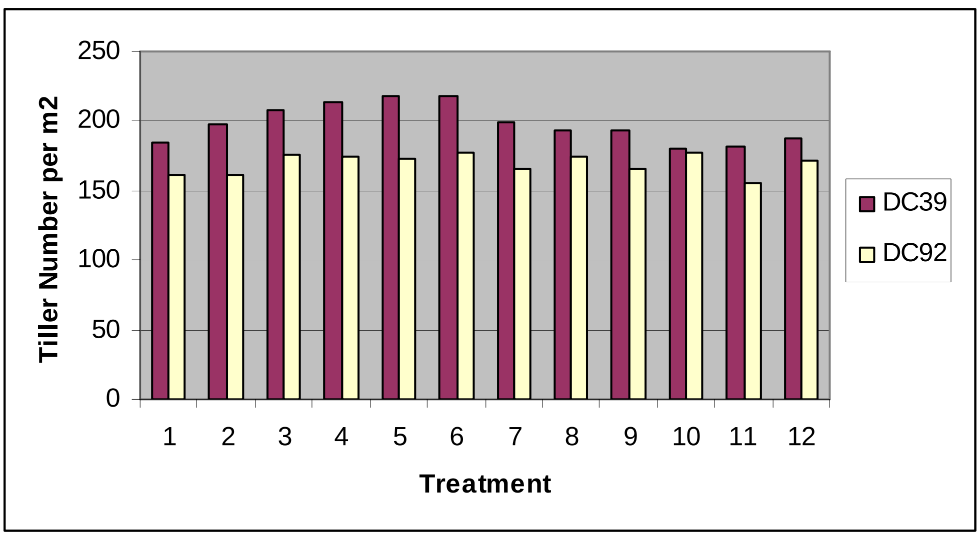


Figure 12. Tiller number per m^2 at flag leaf emergence (DC39) and harvest (DC92)

The conventional system generated higher tiller production during the mid season period compared to the biological system but due to the dry seasonal conditions these tillers were later aborted and the tiller numbers were equivalent across all treatments at time of harvest.

Table 9: Mean grain yield, weight, protein and screenings at harvest

No.	Treatment	Mean Grain Yield (kg/ha)		Grain Weight (kg/hl)		Grain Protein (%)		Grain Screenings (%)	
1	Control A	809.2	abc	82.5	a	12.9	c	6.5	a
2	Control B	832.0	abc	81.9	abc	12.4	c	6.8	ab
3	Control C	765.7	bc	81.1	bcd	15.6	ab	9.4	cd
4	Standard A	910.2	ab	81.1	bcd	15.3	ab	8.8	bcd
5	Standard B	849.1	abc	80.6	de	15.5	ab	8.8	bcd
6	Impact	958.4	a	81.1	bcd	15.2	b	8.1	abc
7	Biological ST	753.3	c	81.0	cde	15.4	ab	8.5	abc
8	VAM Dressing	724.0	c	80.9	cde	15.3	ab	9.1	cd
9	VAM Dressing	716.6	c	80.0	e	15.9	a	9.5	cd
10	New Edge Free-living N	724.8	c	82.1	ab	12.9	c	6.7	ab
11	HybridAgric Free-living N	732.1	c	81.9	abc	12.9	c	7.7	abc
12	P Soluboliser	829.3	abc	80.3	de	15.6	ab	10.8	d
p value		0.0514#		0.0003		0.0000		0.0063	
LSD (5% level)		156.78		1.0160		0.6762		2.128	

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.
Note P value greater than 0.05.

Observations and comments:
The dry seasonal conditions greatly limited the potential growth, development and yield of wheat.

The wheat plants treated with biological seed treatments and with Guano used as a basal fertilizer exhibited less vigorous growth and were delayed in plant development during the tillering stage of development compared to wheat plants sown with double superphosphate. This could be attributed to the lack of available phosphorous during the early stages of crop growth.

Although not always statistically significant, the conventional fertilizer program provided superior early growth and higher yields compared to the biological program.

Sponsors:
Riverine Plains Inc and Murray CMA.
Thanks to Lisa Castleman, Dale Grey, John Sykes for advice and assistance and Charles and Susie Cay for the use of their property.

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NOTE: THIS IS THE ONLY COLOUR AD

Variety trial - Murchison

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Murchison East
Growing Season Rainfall:
GSR: (Apr-Oct) 152 mm
Soil:
Type: Grey Loam over heavy clay
pH (CaCl): 5.2 (0-10cm)
Sowing Information:
Sowing date: 22/5/06
Fertiliser: 100 kg/ha MAP (sowing) + 130 kg/ha Urea (pre-drilled)
Row Spacing: 25 cm
Paddock History:
2005 – Canola
2006 - Wheat
Plot Size: 8.4m x 100m
Replicates: 'Nearest neighbour' trial design

Key messages:

- Of the varieties tested, the early maturing variety Wyalkatchem yielded highest.
- Frost/drought unpredictably and severely reduced yield in many other varieties.

Aim:
To evaluate the performance of several newly 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 100 m x 8.4 m (0.084 ha) using the farmer's air seeder. The plots were sown on the 22nd May 2006 and all varieties were sown at the same rate of 82kg/ha with 100 kg/ha MAP treated with a flutriafol fungicide. Urea was pre-drilled at a rate of 130 kg/ha. Plots were harvested on the 7th December 2006 using the farmer's header and yield measured using a weigh bin.

Results:

Table 10: Yield and quality results from the Murchison variety trial.

Variety	Maturity	Plants/m2	Yield t/ha	Screenings %	Protein %	WUE kg/ha/mm
Wyalkatchem	Early	79	1.16	1.2	13.8	28
Pugsley	Mid	97	0.87	0.6	13.8	21
Ventura	Early-Mid	78	0.79	1.2	13.7	19
Whistler	Mid-Late (w)	89	0.63	0.9	13.8	15
Gregory	Mid-Late	85	0.62	1.1	13.6	15
Ruby	Early-Mid	61	0.58	1.0	13.6	14
Sentinel	Mid-Late	84	0.55	1.0	13.6	13
Diamondbird (avg 5 plots)	Early-Mid	86	0.41	1.0	13.7	10
Sunstate		92	0.32	0.9	13.9	8
CV			**10.2**	**14.8**	**1.8**	
LSD			**0.22**	**0.55**	**0.89**	

Observations and comments:
The crop was direct drilled into very firm soil that came up quite cloddy. This along with delayed germination due to the late break, contributed to the generally low plant establishment figures (61-97 plants/m^2). The dry spring and severe frost events, led to lower than average yields at this site, with results varying from 1.16 t/ha (Wyalkatchem) to as low as 0.32 t/ha (Sunstate). Weed and disease pressures were not factors at this site.

Using the formula that Potential Yield = Growing season rainfall (Apr-Oct) – 110mm (evaporation) x 20, the potential yield for this site was 0.9 t/ha. Of the varieties in the trial, only Wyalkatchem (1.16 t/ha) yielded significantly more than the theoretical maximum, while Pugsley (0.87 t/ha) and Ventura (0.79 t/ha) yielded similarly to the potential yield. All other varieties yielded significantly less than the theoretical maximum.

This area was affected by the widespread frosts that occurred in late September. Varieties close to flowering at this time may have suffered damage to flowering parts, and to anthers in particular, significantly reducing yield potential in affected varieties.

Wyalkatchem, Ventura and Pugsley were the top three performing varieties in this trial. All three have early-mid type maturity and as a result, may have escaped some of the frost damage that affected other varieties, though it is unknown why varieties such as Ruby and Diamondbird were also badly affected. The combination of frost and moisture stress resulted in quite unpredictable variety responses.

While the top three varieties had water use efficiencies (WUE) approaching 20 kg/ha/mm, only Wyalkatchem exceeded this with 27 kg/ha/mm. In moisture limited years, WUE often exceeds 20, but most varieties in this trial had figures less than 20, further confirming that a factor other than moisture (frost) affected yield at this site.

Sponsors:
Farmer Co-Operator: Alistair Newton, Murchison East, Victoria.

Grazing wheat trial

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Nathalia
Growing Season Rainfall: (Apr-Oct) 152 mm
Soil: red loam
Sowing Information:
Sowing date: 3/3/06
Fertiliser: 100 kg/ha MAP (sowing) + 200 kg/ha Urea (split topdressing)
Row Spacing: 23cm
Irrigations
Pre – 15 Feb: 1.4 ML/ha
1st – 25 Mar: 0.9 ML/ha
2nd – 17 Apr: 0.65 ML/ha
3rd – 22 Sep: 0.94 ML/ha
4th (grain) 27 Oct: 1 ML/ha
Paddock History:
2006 – Wheat
2005 – Canola
2004 – Pasture

Key messages:
- Sowing wheat in early March in hot environments is not recommended.
- Mackellar wheat showed promise as a dual purpose, long season variety.

Aim:
To evaluate Mackellar dual purpose grazing wheat under irrigation.

Method:
A 12.3 ha paddock was pre-irrigated on February 15th 2006, and then was sprayed with a mixture of glyphosate and chlorsulfuron. Seed was sown on the 3rd March 2006 at a rate of 80 kg/ha, along with 100 kg/ha MAP. The crop received three irrigations in March, April, and September. A dry matter cut to estimate forage quality was taken in July and samples were sent to FeedTest. The paddock was grazed twice and locked up for hay. The crop received 200 kg/ha of N over two top dressings in July and September. Hay was cut in October. Two bays of the paddock were retained for grain production, and this area received a supplemental irrigation on 27th October 2006. Mackellar is a late season wheat and was harvested on the 28th December 2006.

Results:
From the 6th – 19th June 2006 481 ewes and 478 April-May dropped lambs grazed continuously and the DM crop growth over this time was 1.3 t/ha. The quality of the forage cut at Z30 is presented in Table 11.

Table 11: FeedTest results of wheat herbage cut 21st July 2006

Growth Stage	Z30-31
Dry Matter (%)	20.0
Crude Protein (%)	20.7
ND Fibre(%)	46.0
DM Digestibility(%)	78.5
Met Energy MJ/kg DM	11.9

From 28th July – 14th September 2006 478 lambs grazed continuously and were supplemented ad. lib. with 14% protein 11 MJ pellets with an intake of 450 g pellets/head over this period. Lambs also had access to 1 x 4’ x 4’ roll of shaftal and rye silage per week. The amount of crop growth over this grazing period was 1.6 t/ha.

Hay was cut in October and yielded 4t/ha as is.

Two bays were kept for grain and were watered once in spring. They were harvested on 28th December 2006 and yielded 2.3 t/ha. The straw was baled and yielded 3.5 t/ha.

Observations and comments:
Establishment was very poor, possibly due to a combination of temperature damage at germination and/or damage from the chlorsulfuron herbicide. In some areas, there were less than 20 plants/m^2, consequently early growth was retarded, dry matter production was low and the time to first grazing was quite late given the early sowing date. The FeedTest data showed the quality of the feed to be excellent. The total herbage grown over winter was 2.9 t/ha, which was very handy due to the dry season, but was lower than this early sowing date would suggest. Other research had suggested that 6t/ha over three grazings would have been a realistic expectation. Given this crops set backs, we feel this should still be achievable in this environment.

Due to the shortage of feed, the crop was grazed during the running up phase which would have decreased the dry matter yield of hay.

Mackellar wheat would need at least two irrigations in a normal season due to its late maturity so is not suited to years where irrigation water is scarce.

Sponsors:
Farmer Co-Operator: Mackenzie Craig, Nathalia, Victoria.

Deep soil N testing paddock performance results

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Key messages:
- Drought and frost severely impacted yield of monitor paddocks, making results unreliable.
- Generally poor yields resulted in most monitor paddocks having low N use efficiencies.
- Where grain or hay yields were poor, soil N should be similar to the previous season.

Aim:
To evaluate the performance of paddocks that were deep soil N tested before sowing in 2006.

Method:
Prior to the season break, various paddocks were soil tested to a depth of 60 cm in 0-10 and 10-60 cm intervals. These soil cores were tested for available nitrate and ammonium to provide total N available in kg/ha. The yield and protein results were obtained from the farmer.

Results:

Table 12: History of monitor paddocks

Location	System	Rotation	Variety	Paddock prep.	Sowing date	GSR mm (approx)	Irrigations
Congupna 1	dryland	shaftal/barl	Baudin	Stubble	6-Jul	153	
Boorhaman East	dryland	can/wht	Whistler	Stubble	16-May	161	
Katamatite	dryland	can/wht	Bowerbird	Burnt trails	21-May	n/a	
Kotupna	dryland	can/wht	Ventura	Stubble	16-May	130	
Miepoll	dryland	wht/trit	Abacus	Burnt	16-Jun	169	
Karramomus	dryland	can/trit	Yitpi	Stubble	4-Jun	150	
Waggarandall	dryland	can/wht	Whistler	Stubble	4-May	123	
Congupna 2	irrig.	pers/maize/bar	Baudin	Stubble	23-Jun	153	Sept, Oct
Peechelba East	dryland	can/wht	Diamondbird	Harrowed	9-May	161	
Kaarimba	irrig.	wht/wht	Goldmark	Burnt	30-Jun	144	Sept
Boweya North	dryland	wht/faba/trit	Jaqui/trit	Bean Stubble	12-May	158	
Katamatite East	irrig.	sub/wht/trit/trit	Muir	Burnt	14-May	126	Sept
Bungeet	dryland	can/wht	Whistler	Burnt	5-May	158	
Picola	dryland	can/wht	Janz	Stubble	7-May		
Murchison*	dryland	can/wht	Diamondbird	Stubble	23-May	152	
Katandra	dryland	wht/wht	Chara	Burnt	28-May		
St James	dryland	can/wht	Whistler	Burnt trails	3-Jun		

* Frost affected

Table 13: Yields of hay and grain from paddocks having different N backgrounds

Location	Avail N (0-60 cm) kg/ha	N fert applied (kg/ha)	Date top-dressed	Grain Yield t/ha	Hay Yield t/ha	Protein %	N removed kg/ha	Total N avail^ kg/ha	NUE %
Congupna 1	142.5	15	-		1.8	11	32	178	18
Boorhaman East	102.9	28	6-Sep		5	11	88	151	58
Katamatite	110.4	10	-		2	11	35	140	25
Kotupna	90.12	0	-		1.5	11	26	110	24
Miepoll	135	0	-		4.32	11	76	155	49
Karramomus	117.2	18	-		1.04	11	18	155	12
Waggarandall	97.6	0	-		2.5	11	44	118	37
Congupna 2	106.9	46	28-Aug	6.5		11.8	123	203	60
Peechelba East	132.3	35	Early Sept	2.3		13	48	187	26
Kaarimba	116.9	31	Pre-drilled	1.85		13	38	183	21
Boweya North	130.3	13	-	1.45		13	30	163	18
Katamatite East	81.5	0	-	1.25		13	26	117	22
Bungeet[!]	112.7	46	11-Aug	1.2	3.04	13	25	179	14
Picola	75.8	35	Sowing	0.9		13	19	131	14
Murchison*	131.4	70	Sowing	0.2		13	4	221	2
Katandra	98.1	12	-	0.4		13	8	130	6
St James	132.5	55	Early Sept	0.4		13	8	208	4

* Frost affected
^ Total N available includes soil N, Fertiliser N and mineralisation.
! Lower part paddock frost affected, cut for hay. Higher part paddock retained for grain.

Observations and Comments:

Due to the dry season and widespread frosts, most dryland monitor paddocks yielded poorly. In cases where severe frosts occurred, many farmers chose to cut hay from paddocks unlikely to yield well.

Using the rule of thumb that 40 kg of N is required to produce 1 t grain at 11% protein, all monitor paddocks had enough soil nitrogen in the top 60 cm to yield at least 1.8 t/ha grain without additional fertiliser or mineralisation.

In an 'average' season, we assume north east Victorian mineralisation rates to be approximately 40-50 kg N/ha. Due to the lack of substantial spring rain, mineralisation levels in dryland paddocks were this year assumed to be much lower at 20 kg N/ha. By comparison, irrigated paddocks may have had mineralisation levels of 30-50kg N/ha, depending on the number of waterings.

It is possible to work out how much N was actually used per hectare in each paddock using yield and quality data.

The formula we used to calculate N removal is:

Grain N uptake (kg/ha) = **Protein %** divided by **6.25** x **yield** (t/ha) x **10**

Where actual quality figures were unavailable, we assumed protein figures of 13% for grain and 11% for hay. These figures are slightly higher than average to allow for drought conditions which tends to increase protein.

Monitor paddocks had N removal rates ranging from 8 to 123 kg N/ha, depending on the size of the hay or grain crop harvested. Results are shown in the column titled *N removed kg/ha* in Table 13. The bigger the crop, the more N removed, so paddocks with very low yields (i.e. <0.5 t/ha at Murchison, Katandra and St James) removed negligible N in 2006. Hence most of N available in 2006 would still be available to the 2007 crop.

The 20kg N removed in 1 tonne grain is roughly half that required to produce the tonne of grain. The remaining 20kg N goes into roots, stubble and losses. Exactly how much N is used in the end product (either hay or grain) can be assessed using a measure called the Nitrogen Use Efficiency figure (NUE), which shows how much available N (soil N + fertiliser N + mineralised N) was used in the production of the grain crop. For grain production, target NUE is 50%, for hay it should be higher. Where figures are well below 50%, N is not the limiting factor in grain production, as was the case in 2006 where NUE's were generally well below 50%. The higher NUE's at Congupna 2 (60% NUE, 6t/ha grain yield), Boorhaman (58% NUE, 5t/ha hay yield) and Miepoll (49% NUE, 4.3 t/ha hay) show good use of the available N to maximise yield and involve irrigation or higher rainfall.

Where starting N is known through a soil test, the amount of N remaining in the soil from the previous season can be calculated roughly by subtracting Grain N Uptake (N removal) from the total N available (soil N + mineralised N + fertiliser N). Not all of this will be available immediately in 2007, as some will be tied up in organic matter to become available later in the season.

Sponsors: Farmer Co-Operators, various north east TOPCROP group members.

Soil testing – the phosphorus story

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Key messages:

- Phosphate Buffering Indexes (PBI) for all soils sampled within the north east were in the low-very low categories.
- Some soils might be expected not to respond to fertiliser P.
- The proportion of available P to total P was higher in the non-irrigated paddocks.

Aim:
To determine the Phosphorus status of a range of soil types used for cropping across the north-east.

Method:
Prior to the season break, various paddocks were soil tested to a depth of 60 cm in 0-10 and 10-60 cm intervals. These soil cores were tested for Colwell P, total P (kg/ha) and assessed for Phosphate Buffering Index (PBI).

Results:

Table 14: pH and phosphorus status of a number of soils tested in north east Victoria

Location	Irrig or dryland	Rotation	pH CaCl2 0-10cm	Colwell P	PBI	Available P kg/ha	Total P kg/ha	avail P as a % of total
Kaarimba	irrig.	wht/wht	5.30	20	97	26	519	5.0
Congupna 2	irrig.	pers/maize/bar	6.10	25	64	32	396	8.2
Katamatite East	irrig.	Sub/wht/trit/trit	4.90	36	78	47	490	9.6
Congupna 1	irrig.	shaftal/barl	5.50	53	62	69	710	9.7
Telford Medium	Dryland	wht/barl/can	6.00	59	65	77	461	17.0
Telford High	Dryland	wht/barl/can	6.50	40	65	52	371	14.0
Telford Low	Dryland	wht/barl/can	5.70	61	90	79	537	14.0
Kotupna	Dryland	Can/wht	5.40	35	75	46	467	9.7
Picola	Dryland	Can/wht	5.10	36	53	47	384	12.2
Karramomus	Dryland	Can/trit	4.40	36	68	47	350	13.4
Peechelba East	Dryland	Can/wht	5.20	38	44	49	311	15.9
Waggarandall	Dryland	Can/wht	4.50	39	45	51	351	14.4
Katamatite	Dryland	Can/wht	5.50	45	75	59	486	12.0
Katandra	Dryland	wht/wht	5.20	45	84	58	505	11.6
Boweya North	Dryland	wht/faba/trit	5.50	48	101	62	372	17.0
St James	Dryland	Can/wht	4.90	57	53	74	437	17.0
Bungeet	Dryland	Can/wht	4.80	59	70	77	480	16.0
Boorhaman East	Dryland	Can/wht	5.00	61	81	79	409	19.4
*Murchison	Dryland	Can/wht	5.20	154	87	200	907	22.0

*****This paddock tested unusually high for both Colwell P and total and available P suggesting an anomaly either within the sampling or testing processes.

Observations and Comments:
Is now the time to start mining phosphorus reserves that we've built up over time? This year, as part of our annual soil sampling survey, we included for the first time, a snapshot of the P status of our trial site soils. Most of the soils tested showed Colwell P readings of over 30 mg/kg, which puts these paddocks in the 'high' category. Soil tests at Congupna 2 and Kaarimba show results which put these soils into the 'medium' category. But Colwell P's aren't the full story. The phosphate buffering index (PBI) describes the ability of the soil to tie up P away from plants. The higher the PBI, the more P fertiliser that will need to be added to increase the pool of available P in the soil solution. PBI's measured in these soil test showed a range of 44 – 101 (Table 15). In general terms, PBI's of this order are categorised as low to very low in their ability to tie up P.

Table 15: Categorisation of PBI values

Extremely low	<15
Very very Low	16-35
Very low	36-70
Low	71-140
Moderate	141-280
High	281-840
Very high	>840

P. Moody (Queensland NR&M) has published a recent paper looking at the relationship between Colwell P and the PBI for wheat across SE Australia. To obtain 90% maximum yield, for PBI's ranging from 50 to 100, the Colwell P has ranged from 10-25 to 20-35 respectively. This theory requires further testing, as for many years the standard has been a blanket 30 Colwell irrespective of soil type and more recently people have been trying to achieve 40.

The fact that many paddocks are now way over these values suggests that we have not been utilising all the P we are putting on, not surprising given some of the seasons we have experienced. Due to the speed of some of these Colwell P rises our soils are probably not locking P up to the extent that we may have once thought. It is hard to believe that soils with Colwell P rates over 40 wouldn't yield fine with minimal P input.

Our work in the Picola district after the drought in 2002 showed that cutting rates by 1/3-2/3 worked fine but using zero P led to excessive yield loss when the Colwell was 35. It would be a brave person to use nil P given a small amount with the seed at sowing seemed to be beneficial.

Last year we tested paddocks for total P and this showed large amounts in most paddocks. As a proportion of what was available at sowing the data showed large variation from 5-22%. Most dryland paddocks showed a higher percentage than the irrigated ones. This is plausible given that the wetter soil has the greater biological activity and a greater chance for P to be tied up into the unavailable pool. This also reflects in the fact that P availability is usually better after a drought on dryland, due in part to the lack of biological activity in the previous season.

References: Moody, P.W. (2007) Interpretation of a single point P buffering index for adjusting critical levels of the Colwell soil P test. Aust J Soil Res 45: 55-62.

Sponsors: Farmer Co-Operators, various north east TOPCROP group members.

North East variety trial - Waggarandall

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Waggarandall
Growing Season Rainfall:
GSR: (Apr-Oct) 123 mm
Soil:
Type: Sandy loam
pH (CaCl): 4.5 (0-10cm)
Sowing Information:
Sowing date: 15/5/06
Fertiliser: 100 kg/ha MAP
Row Spacing: 17.75 cm
Paddock History:
2006 – Wheat
2005 – Canola
Plot Size: 1.4 m x 12 m
Replicates: 6

Key messages:

- In this trial, early maturing varieties yielded more than late maturing varieties.
- Plot yield was considerably higher than the theoretical maximum.

Aim:
To evaluate the performance of several newly release wheat varieties against district standard varieties at Waggarandall, in north east Victoria.

Method:
Varieties were sown into canola stubble on May 15th 2006 after a light rain event. All plots measured 1.4 m x 12 m and were sown using a cone seeder. Individual varieties were sown at rates between 73-104 kg/ha, depending on the measured seed size of the cultivar. Seed was sown with 110 kg/ha MAP. The trial had 6 replicates.

Results:

Table 16: Yield, quality and NUE of varieties sown

Variety	Maturity	Max Quality	Yield (t/ha)	Screenings (%)	Protein (%)	N Uptake Efficiency (%)
Wyalkatchem	Early	ASW	1.91	3.6	10.6	32.5
Ruby	Early-Mid	ASW	1.79	4.4	11.2	32.3
Pugsley	Mid	APW	1.72	4.2	11.3	31.0
Gregory	Mid-Late	APW	1.71	4.5	10.6	29.0
Diamondbird	Mid	AH	1.70	4.7	11.3	30.5
Sapphire	Mid	APW	1.62	5.5	10.9	28.3
Chara	Mid-late	AH	1.58	4.8	11.1	28.1
Sunstate	Early-Mid	AH	1.58	5.3	11.6	29.3
Ventura	Early-Mid	APW	1.55	7.9	11.3	28.0
Whistler	Mid-Late (w)	ASW	1.53	5.3	11.6	28.2
Sentinel	Mid-Late	ASW	1.49	4.5	11.2	26.8
Ellison	Mid	APW	1.44	3.3	11.8	27.3
Wedgetail	Mid-Late (w)	APW	1.35	2.7	12.0	25.8
LSD			0.19	0.6	0.5	3.5
CV%			9.9	22.9	3.8	10.3

w- winter habit

Observations and comments:
Seed was sown into moist soil, and plants established well. Due to the dry conditions, weed and disease pressure was low throughout the season, however many plots suffered damage from grazing kangaroos and rabbits, though this did not affect yield (statistical analysis not presented).

Using the formula Potential yield (kg/ha) = Growing season rainfall (GSR) – evaporation* x 20[#]), potential yield at this site was 0.98 t/ha. From Table 16, yields ranged from 1.91 t/ha – 1.35 t/ha and were much greater than was expected. Considering the small plot size, these yields cannot be totally explained by edge effects. History however shows that drought years often lead to WUE figures higher than 20. It is possible that subsoil moisture saved from the previous spring at depth could account for this difference. The sandy hill soil would also have benefited from the light infrequent rain events.

* evaporation calculated as 60% of GSR where GSR <150 mm (French & Schultz, 1984).

20 is the crop factor for wheat and is the kg/ha produced from each millimetre rainfall received in crop.

Maturity class influenced yield in this trial, with the early maturing variety Wyalkatchem (earliest in trial) having the highest yield (1.91 t/ha). While distinguishing between the mid season varieties is difficult, Table 16 shows that the early - mid maturing varieties yielded relatively more than the mid-late maturing varieties, particularly those with a winter habit such as Wedgetail (1.35 t/ha – lowest in trial) and Whistler (1.53 t/ha). It is likely that early season cultivars were able to access moisture for grain filling before the moisture shortage became critical, whereas the longer season cultivars experienced moisture deficits at earlier stages in their development and this affected yield.

The varieties Ruby (1.79 t/ha) and Pugsley (1.72 t/ha) again yielded well, continuing their consistent performance in the north east over the past several years.

Screenings were less than 5% for all varieties except Sapphire (5.5%) and Ventura (7.9%), however protein levels varied with variety.

Nitrogen use efficiency (NUE%) represents the proportion of available nitrogen (soil + applied N) that is used to produce yield and protein. NUE % ranged from 32-26%, which is significantly less than the target NUE of 50%. While there were significant differences between varieties, these are most likely linked to differences in yield associated with the dry season.

Sponsors:
Farmer Co-Operator: Malcolm Pendlebury, Katamatite, Victoria.

Faba Bean trial - Boorhaman

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Boorhaman
Growing Season Rainfall:
GSR: (Apr-Oct) 161 mm
Soil:
Type: red loam
Sowing Information:
Sowing date: 18/5/06
Fertiliser: 100 kg/ha MAP
Row Spacing: 17.5 cm
Paddock History:
2005 – Barley
2004 – Pasture
Plot Size: 6 m x 566 m (0.34 ha)
Replicates: nil

Key messages:
- Faba Beans yielded comparatively well despite the dry conditions.
- Nura yielded more than Farah at this site.
- Neither Nura or Farah were affected by disease.

Aim:
To evaluate the performance of two newly released faba bean varieties, Nura and Farah, in a high rainfall region of north east Victoria.

Method:
The varieties Nura and Farah were sown side by side on the 18th May 2006. Seed was direct drilled into standing stubble using the farmer's airseeder. Soil moisture was marginal at the time of sowing. Plot size was 6m x 566 m, which is equivalent to 0.34 ha. Because of the high sowing rates (Nura target rate 180 kg/ha, Farah target rate 250 kg/ha), seed was sown in 2 passes. No fungicides were applied during the growing season. The beans were harvested on the 13th December 2006 and yields were measured using a weigh bin.

Results:

Table 17: Results of the Boorhaman Faba Bean variety trial

Variety	Seed Size	Seed Colour	Flowering	Maturity	Ascochyta resistance	Choc.Spot resistance	Rust Resistance	Yield (t/ha)
Nura	Small	Buff	Mid	Early-Mid	MR-R	MS-MR	MR	0.736
Farah	Medium	Buff	Early	Early-Mid	R	S	S	0.559

Observations and comments:
Both varieties yielded well given the dry sowing conditions and the exceptionally dry spring. Nura yielded 0.74 t/ha, while Farah yielded 0.56 t/ha, which was a difference of 0.18 t/ha. By comparison, lupins sown in the same paddock lacked the bulk to feed into the header and so weren't harvested. Due to difficulties in adjusting seeding rates at sowing, Nura was sown at a much higher sowing rate than intended (230 kg/ha) and Farah was sown at a much lower rate than intended (217 kg/ha). These differences in planting rates resulted in increased plant establishment rates for Nura (37p/m^2) and lowered densities for Farah (25p/m^2). These differences in plant establishment were sizeable enough to account for the difference in yield between varieties.

Sponsors: Farmer Co-Operator: Damian O'Keefe, Boorhaman, Victoria.

Yield Prophet - North East Victoria

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Key messages:

- Yield Prophet was accurate to within 0.5 t/ha for most dryland crops monitored.
- Soil characterisations will enable more accurate yield predictions.
- A simple model like PyCAL worked well too.

Aim:

To evaluate the performance of Yield Prophet® as a management tool for predicting yield for wheat, barley and canola on irrigated and dryland paddocks in north-east Victoria.

Method:

In early May, soil samples (0-60 cm) were taken from a variety of paddocks and analysed for nutrient status and moisture content. These results, along with rainfall, fertiliser or irrigation inputs, were imputed to the on-line program Yield Prophet. Crops evaluated include wheat, barley and canola. The model was run several times during the growing season to provide a harvest yield estimate. After harvest, final predictions made by Yield Prophet were compared with actual paddock yields.

Results:

Table 18: Results of dryland paddocks entered into the Yield Prophet program

Location	Crop	Date Sown	GSR	PyCAL Pred. (t/ha)	YP Aug min yield predic. (t/ha)	YP Sep min yield predic. (t/ha)	YP Oct min yield predic. (t/ha)	YP harvest yield predic. (t/ha)	Actual grain yield (t/ha)	Actual hay yield (t/ha)	Diff b/twn. actual yield & YP predic (t/ha)
Katamatite	wht	21 May	139	0.25	1.0	0.8	-	0.8	-	2.0	n/a
Telford Med	can	4 May	148	0.37	0.5	n/a	0.5	0.45	0.34		-0.11
Telford High	can	4 May	148	0.37	0.6	n/a	0.7	0.65	0.41		-0.24
Telford Low	can	4 May	148	0.37	0.1	n/a	0.2	0.2	0.5		+0.3
Murchison	wht	23 May	152	0.84	n/a	1.0	n/a	0.95	0.7	-	-0.25
Peechelba	wht	10 May	161	0.67	1.0	n/a	1.0	1.1	2.3	-	+1.2
Kotupna	wht	16 May	130	0.1	0.3	0.5	n/a	0.35	-	<1	n/a
Bungeet*	wht	5 May	158	1.36	0.8	0.8	n/a	0.7	1.2	3.0	+0.5
Congupna 1	bar	6 Jul	153	1.0	0.4	0.5	an/a	0.45	-	1.8 t/ha HAY	n/a

Wht = wheat, can = canola, bar = barley, n/a = not available
* lower half paddock frosted & cut for hay. Top of paddock retained for grain.

Table 19: Results of the irrigated paddock entered into Yield Prophet

Location	Crop	Date Sown	GSR	Pre-irrig. (ML/ha)	# Irrigs	ML/ irrig.	PyCAL Pred.	YP Aug min yield predic. (t/ha)	YP Sep min yield predic. (t/ha)	YP harvest yield predic. (t/ha)	Actual yield (t/ha)	Diff b/twn. actual yield & YP predic (t/ha)
Congupna 2	bar	23 Jun	326*	0	2	0.87	4.9	0.8	3.0	4.0	6.5	+2.5

bar = barley
* includes irrigation

Observations and comments:
Yield Prophet is a sophisticated computer model that uses known soil parameters to model crop growth and yield based on crop inputs and seasonal rainfall. The value of Yield Prophet lies in its ability to predict yield based on the current seasonal outlook and different fertiliser strategies, which in turn allows users to make informed management decisions about inputs. However, in order to predict yield accurately, the model needs specific data, including soil water holding capacity, moisture at sowing, nitrogen (N) status, organic carbon and information on subsoil constraints (i.e. pH). The program also requires information on in-crop rainfall (or irrigation), sowing and fertiliser inputs.

While soil tests and rainfall records provide much of this information, soil characterisation is a difficult process, and not all soils in the region have been fully assessed. As such 'best guesses' were made for some paddocks where information was not available, based on regionally available soil maps and characterisations.

By comparison, PyCAL is a simple computer model that predicts potential yield based on the French and Schulz equation where Potential Yield (kg/ha) = crop water use - 110mm (evaporation), x by the crop factor, (which is 20 for wheat, 22 for barley and 10 for canola). Sowing date and timing of rainfall isn't considered with this model.

Table 18 shows the results of dryland paddocks monitored using the Yield Prophet and PyCAL programs. The monthly predictions presented are for minimum yields, i.e. those that would be most likely if rainfall was in the lowest 10% of all years (decile 1). Yield predictions for an average (decile 5) season steadily declined as the season progressed. From August on, Yield Prophet showed that applying N would not increase yield in most paddocks. Many of the monitor crops were cut for hay due to frost or moisture stress and as Yield Prophet does not predict dry matter production, it was not possible to compare predicted versus actual hay yield.

For those dryland crops kept for grain, Yield Prophet predicted yields to within 0.5 t/ha for all crops (wheat and canola) bar the Peechelba wheat site, which was underestimated by over 1 t/ha. Because Yield Prophet relies on accurate soil characterisations, it is possible the soil parameters selected for this site were inappropriate and that soil moisture was underestimated. The PyCAL program also predicted yields similar to the actual yield at most sites. Again the exception was at the Peechelba site.

Table 19 shows the only irrigated site in this trial. In this case, Yield Prophet underestimated yield by 2 t/ha. Again this was most likely due to an inappropriate soil type selection, which may have underestimated the amount of water available following irrigation or before sowing. PyCAL also underestimated yield at this site, but by a lesser amount (1.1 t/ha).

The variations between predicted and actual yields for both the Yield Prophet and PyCAL programs were acceptable given the generally low yields. A higher yielding season would allow Yield Prophet to be tested to its full potential. In 2007 more paddocks will have had proper soil characterisations which will hopefully improve accuracy.

Sponsors:
Farmer Co-Operators: too many to mention.
Yield Prophet is available through subscription from the Birchip Cropping Group.

Insert full page Murray CMA ad

Merriwagga CWFS trial results 1999-2006

Author: Barry Haskins

Contact No: 02 6960 1320

Organisation: NSW DPI, District Agronomist (Hillston)

Location: Merriwagga, South West NSW
Growing Season Rainfall:
Annual: 370mm
GSR: 220mm
Soil:
Type: Red Sandy Loam
pH (H_20): 7
Sowing Information:
Sowing date: Varies
Fertiliser: Varies
Row Spacing: 25cm
Plot Size: 1ha
Replicates: 3

Key messages:

- Rotations (irrespective of tillage methods) incorporating no more than two cereal crops in sequence with the addition of either a break crop or a fallow once in every three years is ideal.
- The most profitable system since 1999 has been two years of cereal followed by a break crop such as peas under no till.
- No till systems are now becoming more profitable in the trial than cultivated systems under every rotation.
- No till will work on our problem soils so long as effective weed control is achieved.
- Under a continuous cereal rotation, the impact of weeds, diseases and poor nutrition has lowered yields and subsequent profitability.

Background and aims of the trial:
A long term farming systems trial was established in 1999 aiming to investigate the ***sustainability*** and ***profitability*** of ***cropping rotations*** and ***tillage methods*** on Merriwagga soils. The paddock chosen has had a long history of traditional low input cropping. Soils are alkaline red earths (pH 7.2 $CaCl_2$), with a layer of limestone within 60cm of the topsoil. These soils are composed of about 20% clay, 10% silt, 42% course sand and 28% fine sand, categorising them as sandy loam surface textures.

The trial is situated on Geoff and Ian Barber's property approximately 10kms south west of Merriwagga. All operations are conducted using the growers equipment. The trial has 3 replicates of each treatment and totals 30ha in area.

***System treatments*:**

1. **Continuous rotation cropping**: This system involves continuous cropping by rotating crop types. When the trial began, this system was not common practice in this environment. Since the beginning of the trial, more growers are now using break crops. In general, a break crop is grown every second or third year after wheat or barley. The choice of the break crop is mainly determined by the time of break, and disease risks.
2. **Continuous Wheat:** This system is not common in the area, however growers wanted to see what happens if wheat is grown over a long period of time.
3. **Wheat/Barley/Fallow/Wheat**: This system incorporates a fallow instead of a break crop. The aim is to have the system in crop for two years followed by a fallow.
4. **Wheat/Fallow/Wheat**: This is a traditional cropping system still practiced by some growers. The paddock is cropped every second year and fallowed in between aiming to conserve soil moisture, mineralise nitrogen, and break disease cycles.

***Tillage treatments*:**
Each system treatment is divided into two tillage treatments.

1. **No tillage**: This treatment involves sowing with narrow points or discs into an unprepared seedbed. Weed control is by herbicides and if absolutely necessary by burning. Harrowing may occasionally be practiced to remove excess stubble that may hinder sowing.

2. **Multiple tillage**: This system uses conventional tillage fallows and tillage to prepare the seedbed and remove/incorporate stubbles. Herbicides are still used in this system, however cultivation is still used as a method of weed control. This treatment aims to emulate the district tillage practices which were common when the trial began.

Results and discussion from 2006:
2006 started out as a very dry season, with only 6.2mm falling from January to the end of May. The first good rain which allowed sowing to commence occurred in early June. The 43mm that fell in June enabled most people to get most of their crop in by mid July. Unfortunately, the season halted in August, and rainfall for the year totalled only 119.8mm, with 98mm falling between April and October. Temperatures in the spring were lower than average, which helped later crops finish without too much stress.

2006 Cropping Details:
Wheat sown with 10m John Deere single disc airseeder + press wheels on 25cm rows.
Peas sown dry with 15m flexicoil airseeder + press wheels on 22.5cm rows.

Table 20: Crop details 2006

Crop	Variety	Rotation	Sowing Rate	Fertiliser	Sowing Date
Wheat	Ventura	Continuous Wheat	35kg/ha	80kg/ha MAP	17th June
Wheat	Ventura	Rotation 1	35kg/ha	65kg/ha MAP	17th June
Wheat	Ventura	W/F/W	35kg/ha	65kg/ha MAP	17th June
Peas	Kaspa	Rotation 2	120kg/ha	55kg/ha DAP	7th June (dry)

Observations and comments:

Discussion point 1: Yield and gross margin

- As expected, rotations that had subsoil moisture at sowing yielded higher than those following a previous crop.
- There was no significant difference in yield between tillage methods for the W/F/W and the continuous wheat rotations.
- No till yielded significantly higher than multiple tillage in Rotation 1 (wheat after peas) and Rotation 2 (peas after wheat).
- The gross margin for no till was higher under every rotation than for multiple tillage.
- Interestingly, the protein levels of wheat were higher under no till rotations, irrespective of yield.

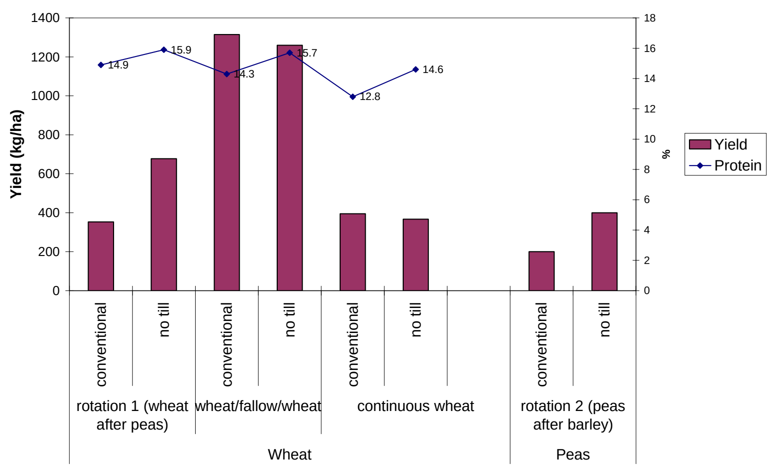

Figure 13. Treatment yield and protein 2006

Table 21: Budgets for each treatment 2006 (note all costs are calculated at contract rates)

	Crop	Tillage	Yield (kg/ha)	Income	Expenses	Gross Margin
Rotation 1	*Wheat after peas*	conventional	352	$98.70	$189.35	-$90.65
		no till	677	$189.69	$140.92	$48.77
Wheat/fallow/wheat	*Wheat after fallow*	conventional	1315	$368.26	$189.35	$178.91
		no till	1260	$352.91	$139.68	$213.23
Continuous wheat	*Wheat after wheat*	conventional	395	$110.60	$232.00	-$121.40
		no till	367	$102.76	$188.71	-$85.95
Rotation 2	*Peas after barley*	conventional	200	$56.00	$209.47	-$153.47
		no till	400	$112.00	$192.96	-$80.96
Wheat/fallow/wheat	*Fallow after wheat*	conventional	-	$0.00	$121.06	-$121.06
		no till	-	$0.00	$22.56	-$22.56

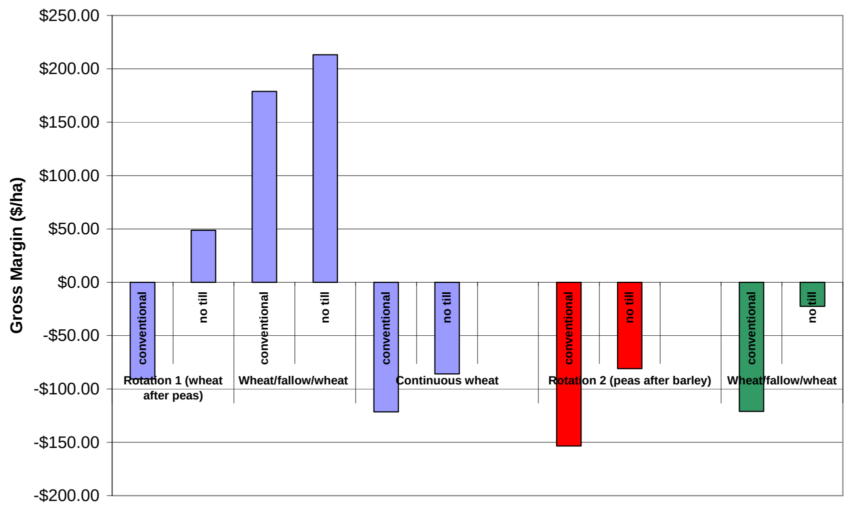

Figure 14. Gross Margin analysis for treatments at harvest 2006

Discussion point 2: Impact of rotation and tillage on disease

- Leaf diseases were not an issue in 2006 under any rotation or tillage treatment. This has been the case since the trial began.
- Rhizoctonia seems to be the biggest disease risk, especially in the continuous cereal rotation.
- Whilst the risk of rhizoctonia is higher under a no till system, a break crop such as peas or even a fallow seems to lower the risk of the disease considerably.
- Pratylenchus neglectus nematodes seem to follow a similar risk pattern to rhizoctonia, where numbers are higher under no tillage, continuous cereal systems. These two pathogens seem to link closely together, but as stated before can be minimised by proper rotations.

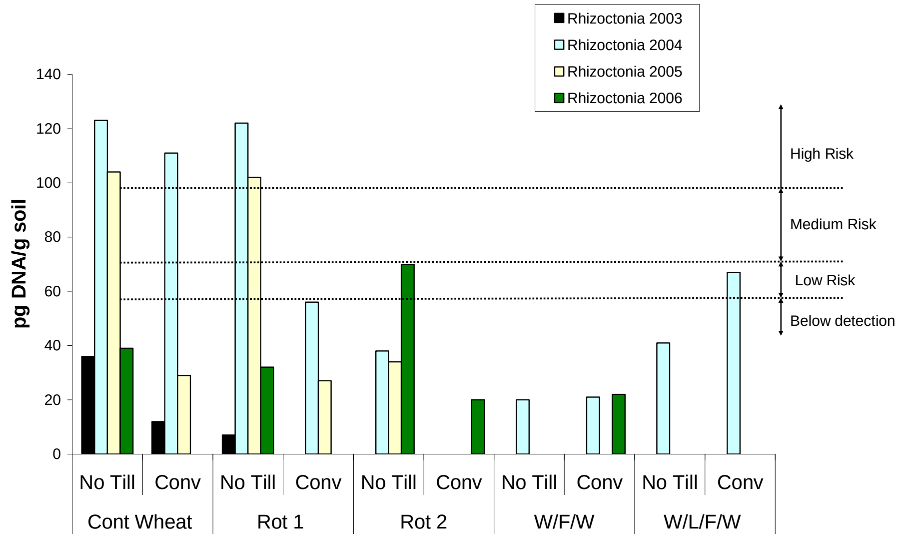

Figure 15. Rhizoctonia levels apparent in all treatments from 2003 to 2006 measured by Predicta B root disease tests

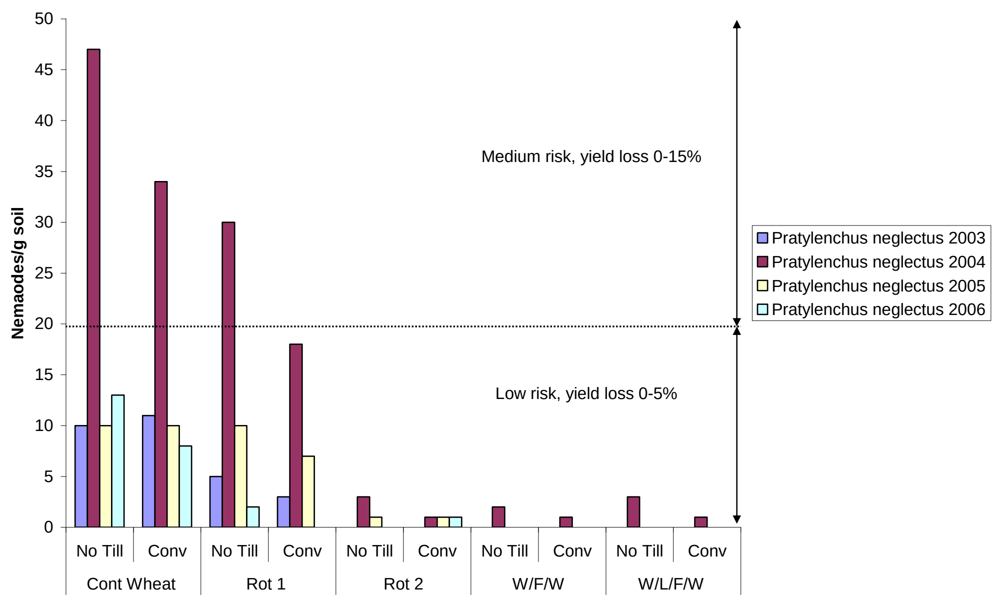

Figure 16. Nematode levels (P.neglectus) in all treatments from 2003 to 2006 measured by Predicta B root disease tests

Discussion point 3: Impact of rotation and tillage on weeds

- As expected, continuous cereal rotations favour higher weed numbers of both ryegrass and wild oats. Broadleaf weeds show a similar trend.
- No till tends to favour ryegrass, where tillage favours wild oats.
- Lowest weed numbers were found when no till was used in a proper rotation, particularly following a chemical fallow.
- Higher weed numbers in continuous cereal rotations favour the build up of herbicide resistance, which has now become an issue after 6-7 years of continuous wheat.

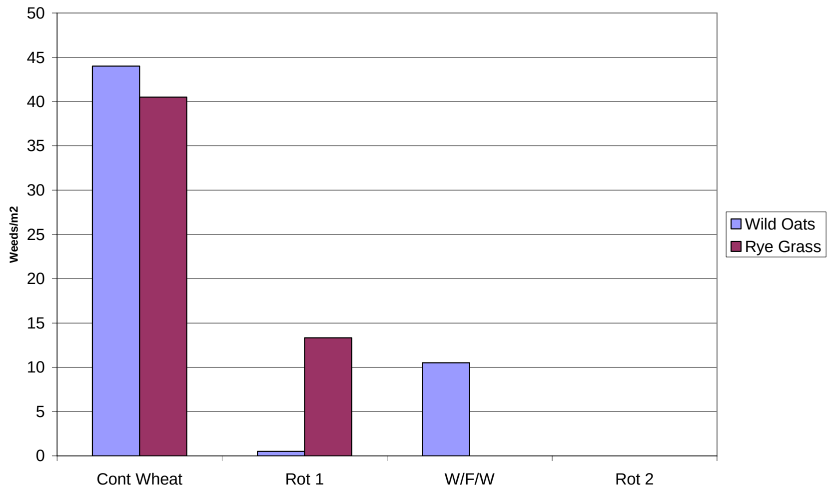

Figure 17. Effect of rotation on weed density and type

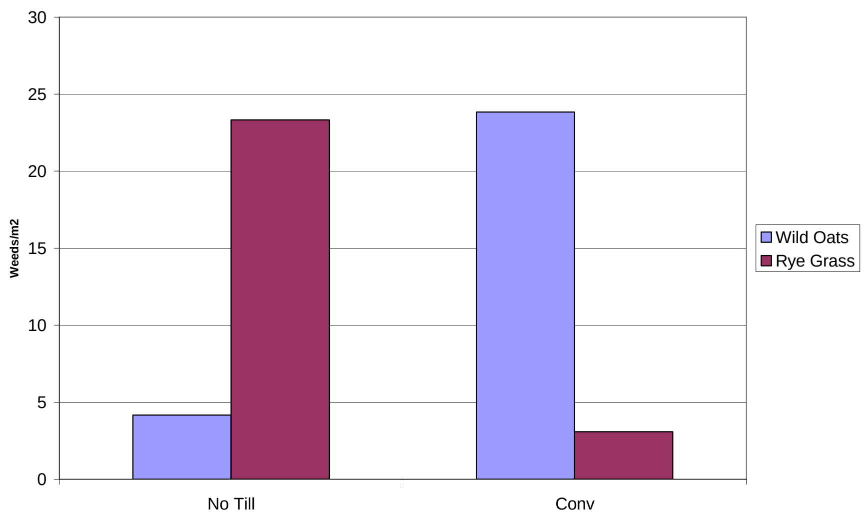

Figure 18. Effect of tillage on weed density and type

Discussion point 4: Gross margin comparisons since the trial began

- Gross margins are calculated assuming all operations are performed by a contractor. This makes the income generated look lower than expected.
- The most economic system in the trial is Rotation 1 (wheat after peas) under a no tillage treatment.
- Figure 20 highlights that the 'lag' period of no till rotations experienced in the first 3 years of the trial have now bounced back in the continuous cropping rotations. This is also the case in the chemical fallow rotations, where wheat has been performing economically better following a chemical fallow rather than a cultivated fallow over the past two seasons.

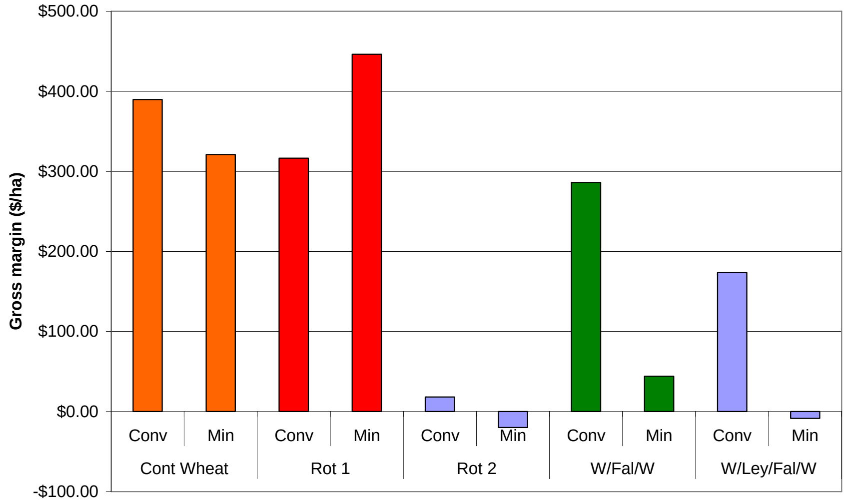

Figure 19. Long term gross margins/ha from 1999 to 2006

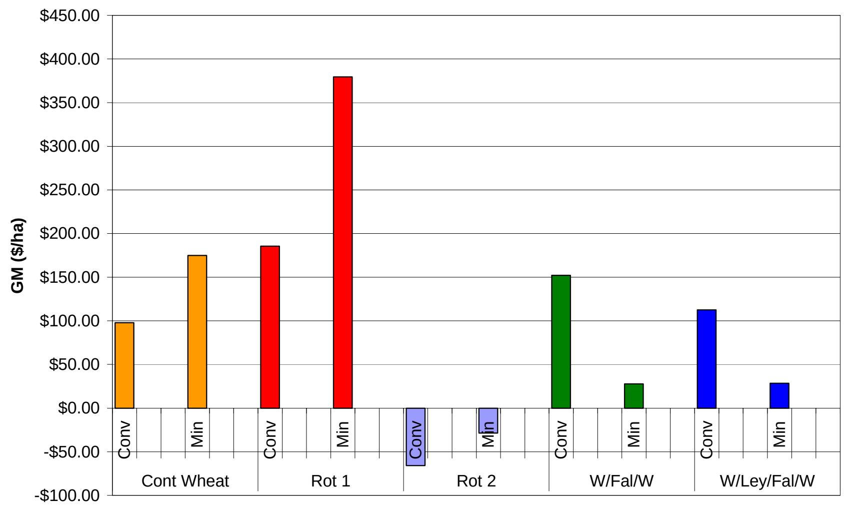

Figure 20. Gross margins from 2003 to 2006, showing the increase in the profitability in no-till farming in continuous cropping over this period

Discussion point 5: Impact of rotation and tillage on soil health

- After 8 years, it is still difficult to measure any changes in soil health.
- Soil nutrient levels whilst varying following different rotations have remained consistent between tillage methods.
- One significant change that has occurred however is the incidence of glomalin, a protein produced by Arbuscular mycorrhizal fungi. Glomalin has been shown to act as a ‘glue’ in the soil, giving it tilth and stability. The associated fungi have many small hyphae, which cover much more soil area than plant roots. These hyphae supply plant roots with nutrients (particularly phosphorous) and moisture. In return the fungi use carbon from the plant to grow and make glomalin.

Glomalin levels were measured in 2005, and were significantly higher in no till systems than conventional systems. This is probably because cultivation destroys fungal hyphae. Further testing will continue in 2007.

Acknowledgements:
All of this work has been possible thanks to a great committee of farmers and industry representatives. In particular we thank our farmer Co-Operators: Geoff and Ian Barber, “Sylvanham” Merriwagga, and the Merriwagga CWFS Committee.

We also receive a generous amount of resources from our local site sponsors listed below:

NSW DPI, Elders, Rawlinson and Brown, Landmark Griffith, Yenda Producers, Agrichem, AWB Seeds, Bayer, Case Intersales, CropCare, Codemo Machinery, Commonwealth Bank, Concepts Cropping, ECOM Commodities, Dow AgroSciences, Dupont, Farmoz, GrainASSIST, Harrison Spray Contracting, Harry Shaddock Seed Grading, HiFert, Incitec/Pivot, Intersales, Mobil, Nufarm, Pioneer Seeds, PlanTech, Rabobank, Pioneer, Suncorp, Syngenta, Vic Chemical Co, Murrumbidgee and Lachlan CMA’s.

Boorhaman stubble management project – evidence of poor topsoil structure in the Boorhaman and Rutherglen districts

Authors: Rob Harris, Judy Drake, Pauline Mele, Nathan Heath and Phil Newton

Contact No: 02 6030 4500

Organisation: Boorhaman Landcare Group and DPI Victoria, Rutherglen

Key messages:

- Low levels of organic carbon, cation exchange capacity and soil microbial biomass are key indicators of an unhealthy soil.
- A history of cultivation and stubble burning of cropping soils has reduced organic matter inputs and hence contributed to a decline in soil health.
- Retaining crop residue by reducing stubble burning and cultivation can potentially increase populations of beneficial microbes such as bacteria and fungi responsible for binding soil particles onto crop residue and helping to produce more friable, better-structured soils.

Aim:

To assess current soil health of cropping paddocks in the Boorhaman and Rutherglen districts.

Method:

Samples were randomly collected from soils to a depth of 10 cm in five selected paddocks located in the Boorhaman and Rutherglen districts to determine levels of organic carbon, cation exchange capacity and soil microbial biomass. Samples were also collected from adjacent roadside areas to compare soil microbial biomass with paddock measurements.

Results:

Table 22: Key soil chemistry indicators of soil health

Paddock	Soil organic carbon[A] (%)	Cation exchange capacity (CEC)[B] (milliequivalents per 100g of soil)
DPI-Rutherglen (Rutherglen)	1.4	5.3
Bakers (Rutherglen)	1.0	3.7
Tweddles (Boorhaman)	1.8	6.1
O'Keefes (Boorhaman)	1.0	3.8
Goldsmiths (Boorhaman)	1.3	3.8

[A]desirable levels of organic carbon 2-4%, [B]desirable CEC levels for clay loam soils 15-25

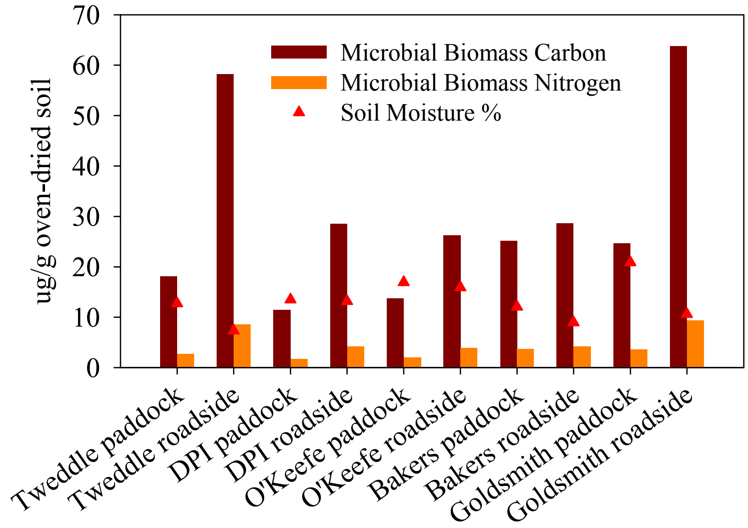

Figure 21. Soil microbial biomass as measured from paddocks and adjacent roadsides at five sites in the Boorhaman and Rutherglen districts.

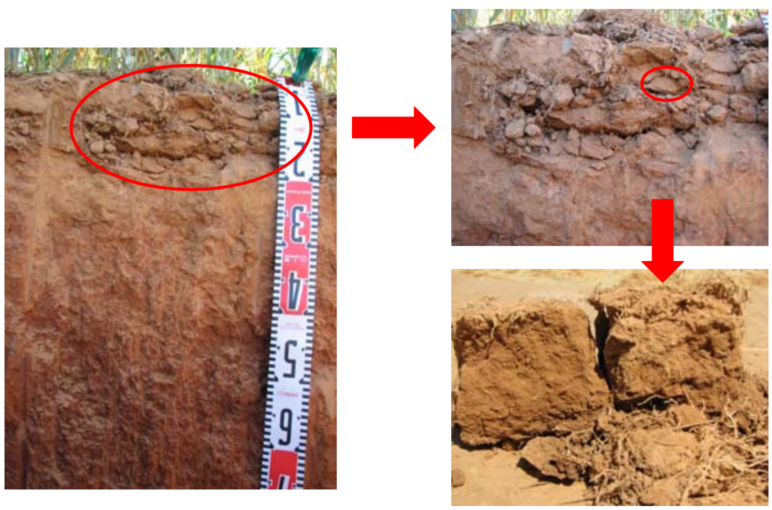

Figure 22. Pictures of a soil pit face showing a poor topsoil structure and restricted wheat root growth found in a cropping paddock from the Boorhaman district.

Observations and comments:

There is evidence that poor topsoil structure is interfering with wheat root growth, reducing root access to the most fertile part of the soil in cropping paddocks from the Boorhaman and Rutherglen districts. Poor topsoil structure is often associated with a combination of frequent stubble burning, cultivation and compaction from heavy machinery. Along roadsides with a history of less frequent burning and cultivation, soil microbial populations were generally greater (Figure 21). Retaining crop stubble can encourage beneficial microbes like bacteria and fungi, which are important for helping bind soil particles onto crop residue producing more friable, better-structured soils.

Sponsors:

National Landcare Program.

Boorhaman stubble management project – canola performance under different stubble management treatments in 2006

Authors: Rob Harris, Andrew Russell and Phil Newton

Contact No: 02 6030 4500

Organisations: Boorhaman Landcare Group, Baker Seed Company and DPI Victoria

Location: Rutherglen
Growing Season Rainfall:
Annual: 245 mm
GSR: 169 mm
Soil:
Type: sandy loam over clay
pH ($H_2$0): 5.8
Sowing Information:
Sowing date: 20 May 2006
Fertiliser: 100 MAP
Row Spacing: tyne 10 inch, disc 7.5 inch
Paddock History:
2006 – Canola
2005 – Wheat
2004 – Lupin
Plot Size: 50 x 250 m
Replicates: No replicates

Key messages:

- After sowing into mulched wheat stubble, establishment and subsequent production of canola was poorer using a disc seeder compared with a tyned seeder.
- Emergence of the canola crop sown with the tyned seeder was improved because the stubble was parted away from the drill row into the inter-row and led to less stubble accumulation above the seed.
- Previous research has described poor canola emergence as a result of excessive stubble build up above the canola seed.

Aim:
To measure canola performance after sowing with tyne and disc seeders into burnt and mulched wheat stubble.

Method:
A demonstration site located on a commercial farm at Rutherglen was set up to compare canola establishment and production under mulched and burnt wheat stubble. Two different methods of sowing canola were used; a tyned seeder (photo 1) and a disc seeder (photo 2).

Results:

No difference in canola establishment and production was found between the tyne and disc seeder when sowing canola into burnt stubble (photos 3 and 4; Table 23). However, where canola was sown into the mulched stubble using the tyne seeder (photo 5 and 6; Table 23) establishment and production was much greater compared with canola sown with the disc seeder (photos 7 and 8; Table 23).

Table 23: Canola measurements taken at the Bakers demonstration site

Treatment	Crop emergence (plants/m^2) 12 July 2006	Crop biomass (t DM/ha) 27 September 2006
Stubble burnt (tyned seeder)	48	3.8
Stubble burnt (disc seeder)	41	3.8
Stubble retained (tyned seeder)	54	3.5
Stubble retained (disc seeder)	23	2.6

Observations and comments:

When sowing canola into heavy wheat stubble it is important to prevent residue accumulating in the drill row. Although the canola crop in 2006 was harvested for hay rather than grain due to frost damage late in the growing season, the potential for grain yield was much greater where canola was sown using tynes compared to discs.

Sponsors:

National Landcare Program.

How effective are new inoculant technologies for the nodulation of grain legumes?

Author: David Pearce

Contact No: 02 6030 4500

Organisation: DPI Victoria, Rutherglen

Key messages:
- Inoculation with granular or freeze dried rhizobial inoculant formulations can produce nodulation of grain legumes equivalent to that of peat slurry inoculants with significantly less preparation required.
- Products vary markedly in their ability to provide nodulation of grain legumes.

Location:
Brocklesby, NSW.

Researchers:
Dr Matthew Denton and David Pearce, DPI Victoria, Rutherglen.

Introduction:
The delivery of inoculants of root nodule bacteria (rhizobia) by peat slurry application is reputed to be difficult and time-consuming for land holders. The recent introduction of new delivery technologies allows greater ease of application and avoids the need for manual seed inoculation. The development of new inoculant products is therefore likely to assist 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 the 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 in the farming community, the aim in this study was to assess the ability of new delivery systems to nodulate grain legumes in a range of Australian soils. Experiments were conducted across a range of environments in Victoria and southern New South Wales. In this report we have focussed on trials conducted at Brocklesby (NSW), which provide a good representation of our findings from over the last four years.

Trial Inputs:
Granular inoculants were purchased (Bay Classic Pty Ltd (Alosca)) or supplied by the manufacturer (Becker Underwood Australia) and stored according to the manufacturers' specifications - Becker Underwood Pty Ltd granules at 4^0C and Alosca granules at room temperature. Granules were applied at two sowing depths (with seed and 2 cm below seed) and at two rates (5 and 10kg/ha).

Freeze dried root nodule bacteria supplied by New-Edge Microbials was also stored according to the manufacturers' instructions and applied onto the seed and injected into the drills at sowing, at a rate of one small vial per 500kg of seed.

Trial Design:
The four field trials located at Brocklesby were randomised block designs with plot sizes of 21.3 m^2 with three or four replicates of each species x treatment combination.

All trials were sown with a cone seeder, with the granules sown through the cone together with the seed and superphosphate (120 kg/ha single super). The cone seeder was sterilised after each treatment to eliminate potential contamination of rhizobial treatments. Best practice weed and pest management was undertaken.

Plant sampling was undertaken twice during the growing season with a total of twenty plants taken per treatment.

Table 24: Treatment List

Treatment	Treatment list
Alosca 10	Alosca bentonite clay granules sown @ 10kg/ha with seed
Alosca 10 U	Alosca bentonite clay granules sown @ 10kg/ha 2cm below the seed
Alosca 5	Alosca bentonite clay granules sown @ 5kg/ha with seed
Becker Underwood 10	Becker Underwood peat granules sown @ 10kg/ha with seed
Becker Underwood 10 U	Becker Underwood peat granules sown @ 10kg/ha 2cm below the seed
Becker Underwood 5	Becker Underwood peat granules sown @ 5kg/ha with seed
E-Rhiz inject	EasyRhiz injected by nozzles into drill rows at sowing
E-Rhiz on seed	EasyRhiz applied to seed

Note : Recommended rates for Alosca products are 8 to 10 kg/ha with the Becker Underwood an experimental granule with no fixed rates at the time of testing.

Trial Results:
In the faba bean and chickpea field trials peat inoculation improved the nodulation of plants compared with the uninoculated treatment (Table 25 and Table 26). Shoot mass and grain yield showed no differences most likely due to the drought conditions in the 2006 growing season, although grain N is likely to be improved from inoculation (data not yet obtained).

Experimental peat granules from Becker Underwood and freeze dried inoculant from New-Edge Microbials provided similar nodulation as the peat inoculants. Alosca granules that were designed for acid sandy soils did not improve nodulation significantly above that of the uninoculated trials.

Table 25: Nodulation of faba beans following inoculation with a range of granular inoculants

Treatment	Nodule number (per plant)	Nodule Score (per plant)	Nodule Dry Mass (mg / plant)
Alosca 10	0.83	0.44	3.7
Alosca 10 U	0.11	0.18	0.7
Alosca 5	0.42	0.31	2.9
Uninoculated	0.00	0.06	0.1
Peat	19.50	3.34	55.7
LSD	**3.02**	**0.40**	**5.1**

Treatment	Nodule number (per plant)	Nodule Score (per plant)	Nodule Dry Mass (mg / plant)
Becker 10	25.1	2.84	45.1
Becker 10 U	14.60	1.88	26.9
Becker 5	19.30	2.08	26.7
Uninoculated	0.00	0.06	0
Peat	19.50	3.34	55.7
LSD	**9.39**	**0.92**	**13.6**

Table 26: Nodulation of chickpeas following inoculation with a range of granular and freeze dried inoculants

Treatment	Nodule number (per plant)	Nodule Score (per plant)	Nodule Dry Mass (mg / plant)
Alosca 10	0.83	0.96	27.7
Alosca 10 U	0.83	0.25	17.4
Alosca 5	0.20	0.20	9.9
Uninoculated	0.18	0.25	2.3
Peat	9.72	2.51	80.4
LSD	**2.19**	**0.43**	**14.7**

Treatment	Nodule number (per plant)	Nodule Score (per plant)	Nodule Dry Mass (mg / plant)
Becker 10	10.08	2.60	75.7
Becker 10 U	3.38	1.39	37.2
Becker 5	7.98	2.48	79.7
E-Rhiz inject	10.75	2.55	83.5
E-Rhiz on seed	11.50	2.59	114.5
Uninoculated	0.18	0.25	2.3
Peat	9.73	2.51	80.4
LSD	**3.35**	**0.65**	**31.9**

Field Trial Summary:

Field trials in the 2006 season often showed poor plant growth and low grain yields due to the drought conditions. Nodulation results were, however, very informative and strong responses were observed typical of previous seasons which experienced more typical rainfall regimes. Further evaluation of emerging inoculants is being conducted in Victorian and southern NSW environments to understand the responses of inoculants in a range of environmental and edaphic conditions.

Although granular carriers provide a range of advantages for delivery of rhizobia, there are a number of issues that need to be considered. To provide equivalent numbers of rhizobia, 20-40 times the volume of inoculant is typically required for granular application (5-10 kg / ha depending upon legume species and row spacing versus 250 g for a peat slurry inoculant). This increases the cost of using granular inoculants due to an increased volume of material to supply inoculant and increased transportation costs. The granular products are approximately 3 times the price of the traditional peat slurry, but prices fluctuate with time and it is best to confirm current pricings before making a decision on these products. Granular inoculants are also best applied with seeding equipment in which granules can be contained using a separate seeder box. Granular inoculants are usually not mixed with grain legume seed as granules settle to the bottom of the sowing box. In addition, the interaction of granules with fertilisers needs to be considered, as this may have an impact on the efficacy of rhizobia within the granules. The introduction of these new inoculant delivery methods may offer land holders greater choice of inoculant product that best suits their operations and budget.

Acknowledgements:

Mr Garry Drew provided excellent assistance in the maintenance of the field trials and feedback throughout the season. Becker Underwood Australia is thanked for the provision of experimental peat granules for these trials.

Funding:

We thank GRDC/AWI and DPI Victoria for their ongoing funding through the National *Rhizobium* program.

Characterising soils for plant available water capacity

Authors: Neal Dalgliesh*, Steve Henry[1] and Brett Cocks*

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Organisation: CSIRO Sustainable Ecosystems, *Toowoomba and [1]Canberra

Key messages:

- Soil water storage capacity and availability of stored water are important drivers of crop production systems in southern cropping regions of Australia.
- The plant available water capacity (PAWC) of the measured soils ranged between 96 and 156mm for wheat.
- Differences in PAWC were a result of differences in soil textures, sub-soil constraints and rooting depth.
- Potential exists within the existing project for additional regionally important soils to be characterised through collaborative activity with local farmers.

Aim:

Differences in the ability of soils to store water is an important factor in understanding why some crops perform better in certain areas of a particular paddock than others. This research was aimed at determining the differences in Plant Available Water Capacity (PAWC) between soils in three paddocks at Rand, Dookie and Yarrawonga. All paddocks had been zoned into 3 distinct production areas using a combination of yield mapping and other precision agriculture techniques including Electro Magnetic Induction (EM) surveying. This activity was undertaken to increase farmer and consultant understanding of the soil resource, and to allow tools such as *Yield Prophet* to be used to predict yield probability for individual zones and efficient allocation of expensive inputs such as nitrogenous fertiliser.

Method:

Characterisation sites representative of the zones within each paddock were identified by the farmers and were established by the researchers. Each characterisation site was measured for Drained Upper Limit (DUL - the amount of water able to be held against gravity by a particular soil), Bulk Density (BD - a measure of how dense the soil is) and Crop Lower Limit (CLL-the water extraction capacity of a particular crop on a particular soil type).

Sites were wet up to a depth of 1.5-2.0 m over a number of weeks using simple drip irrigation techniques and sampled for DUL and BD once fully wet and drained. Soil sampling for CLL was undertaken at the time of site establishment (in December 06), after the preceding crop had extracted all available water. Soils were sampled in increments of 0-15, 15-30, 30-60, 60-90, 90-120, 120-150 and 150-180 cm down the profile.

Results:

Table 27 provides PAWC information and some of the measured soil chemistry for each site. PAWC values ranged between 96 and 113 mm for the 2 sites at Yarrawonga where sub-soil constraints, including higher levels of chloride, were impacting on water availability, to 150-180 mm at Dookie and Rand where soils were not constrained by salinity and graded into clay at depth. Please note that CLL data should be used with some caution until confirmed during the 2007 season.

Observations and comments:
PAWC can be considered as the size of the soil water bucket available to be filled by rainfall. How full that bucket is at the start of the season (or at any other time) will depend on many factors, including the amount and timing of rainfall, surface cover, weed management and slope. The availability of these data, when combined with pre-season monitoring of soil water (thought of as the amount of water in the bucket), allows farmers and consultants on similar soil in the Riverine Plains, to use tools such as *Yield Prophet* to explore seasonal potential with much more confidence than in the past. It is expected that with continuing collaboration from Riverine Plains farmers that more regionally important soils will be characterised over the coming seasons. A complete list of soils characterised for Australia is available at http://www.apsru.gov.au/apsru/.

Table 27: PAWC and measured soil chemistry information

		SOIL WATER						CHEMISTRY		
Site	Soil	Depth (cm)	BD (g/cc)	DUL (% Vol)	WHEAT CLL (% Vol)	WHEAT PAWC (mm/layer)	WHEAT PAWC (mm total)	pH (Cacl2)	Cl (mg/kg)	OC (%)
Yarrawonga	Sandy Clay Loam over clay	0-15	1.52	31.7	22.0	15	96	6.3	35	1.03
		15-30	1.40	39.1	22.8	24		7.0	35	0.51
		30-60	1.53	34.3	28.9	16		7.9	379	0.24
		60-90	1.63	30.7	26.4	13		8.1	727	0.09
		90-120	1.62	29.0	27.2	6		8.1	788	0.09
		120-150	1.61	31.4	26.2	16		8.1	871	0.07
		150-180	1.66	29.3	27.0	7		8.1	961	0.07
Yarrawonga	Clay	0-15	1.30	32.4	18.0	22	113	7.2	19	1.00
		15-30	1.26	43.3	21.9	32		7.3	30	0.63
		30-60	1.30	42.8	31.3	35		8.0	421	0.35
		60-90	1.38	40.0	34.0	18		8.1	1044	0.23
		90-120	1.43	37.9	35.8	6		8.1	1409	0.17
		120-150	1.46	37.0	36.5	1		8.1	1480	0.12
		150-180	1.43	38.1	38.1	0		8.0	1723	0.12
Dookie	Loam over Clay	0-15	1.32	34.0	17.0	26	157	4.8	41	1.58
		15-30	1.53	33.4	17.0	25		5.3	23	0.71
		30-60	1.53	34.4	18.0	49		6.5	80	0.45
		60-90	1.59	31.8	23.0	26		7.3	300	0.28
		90-120	1.52	34.5	28.0	20		7.5	375	0.10
		120-150	1.49	35.9	32.0	12		7.9	517	0.07
		150-180	1.52	34.7	34.7	0		8.0	519	0.05
Dookie	Sandy Loam over Clay Loam	0-15	1.45	26.0	15.0	17	181	5.0	32	1.20
		15-30	1.61	24.6	15.0	14		4.8	1	0.32
		30-60	1.67	29.0	15.7	40		6.0	1	0.25
		60-90	1.78	24.7	15.1	29		6.4	1	0.13
		90-120	1.57	32.8	26.5	19		7.6	1	0.17
		120-150	1.46	37.1	24.0	39		7.6	1	0.15
		150-180	1.59	30.8	23.0	23		7.4	16	0.13
Dookie	Loamy Sand over Clay	0-15	1.56	12.6	5.0	11	141	4.9	1	0.42
		15-30	1.76	12.6	5.0	11		4.2	1	0.17
		30-60	1.71	11.5	5.0	19		4.1	1	0.07
		60-90	1.67	29.1	8.0	63		5.8	1	0.08
		90-120	1.59	32.0	25.1	21		6.1	1	0.07
		120-150	1.69	28.4	25.0	10		6.3	1	0.14
		150-180	1.60	31.7	30.0	5		6.4	1	0.10
Rand	Sandy Clay Loam over Clay	0-15	1.29	22.5	10.0	19	139	5.4	111	1.25
		15-30	1.52	22.7	10.0	19		6.1	93	0.36
		30-60	1.48	27.9	15.5	37		6.3	98	0.20
		60-90	1.49	33.4	23.6	29		6.7	51	0.13
		90-120	1.47	34.9	28.0	21		7.1	31	0.12
		120-150	1.34	33.8	29.0	14		7.2	20	0.12
Rand	Sandy Clay Loam over Clay	0-15	1.45	25.6	9.7	24	102	4.7	125	1.20
		15-30	1.57	24.1	7.6	25		5.2	94	0.45
		30-60	1.45	35.2	21.1	42		5.9	100	0.18
		60-90	1.54	33.9	30.3	11		6.4	52	0.18
		90-120	1.49	30.7	30.7	0		7.0	36	0.10
Rand	Clay Loam over Clay	0-15	1.39	29.9	15.8	21	150	5.4	83	1.14
		15-30	1.54	33.3	17.1	24		6.2	83	0.50
		30-60	1.46	36.8	22.0	44		7.2	90	0.27
		60-90	1.46	37.0	28.0	27		7.9	68	0.17
		90-120	1.55	33.6	28.0	17		7.9	48	0.08
		120-150	1.59	32.1	28.0	12		7.9	37	0.10
		150-180	1.61	31.2	30.0	4		7.9	31	0.07

Sponsors:
This work forms part of the GRDC project 'Training growers to manage soil water', a 3 year project (2006-2009) to increase the level of understanding of soil water amongst growers and their consultants, and to provide tools for better monitoring and management of soil water. Collaboration with farmers of the Riverine Plains farmer group is greatly appreciated.

Making canola forage – 2006/07

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Organisation: [1]DPI Victoria, Cobram and [2]DPI Victoria, Ellinbank

The 2006/07 season was significant due to the large amount of canola cut for hay and silage as a result of the effects of drought and frost. Those people that had "reasonable" crops found that the returns from hay were far better than if badly frosted and drought stressed crops were kept for grain. Canola that progressed to harvest was generally of a poor quality.

Due to the large amounts of hay and silage made in 2006, DPI's FeedTest service was able to assess a large number of samples submitted for quality testing. In 2006/07, 612 canola samples were submitted compared to 100 samples in the period 2002-2005.

Table 28 is a summary of canola hay and silage quality testing undertaken by FeedTest in the 2006/07 season. The table includes samples submitted up to 10/1/2007.

Table 28: Summary of Canola hay and silage quality from FeedTest data 2006/07

	Digestibility DDM%		Crude Protein CP%		Energy ME MJ/kg		Fibre Neutral Digestive Fibre %	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**
Silage (104 samples)	66.3	45.6-81.7	17.6	9.7-26.3	10.1	7.3-12.4	41.5	25.6-57.4
Hay (508 samples)	67.1	33.0-85.3	16.2	4.0-27.2	9.9	4.1-13.1	40.6	25.4-66.9

For the 2006/07 season, the dry matter (DM) content of silage averaged 46.9% (range 24.8-75.7%) while the DM for hay averaged 84.8% (range 61.3-93.5%). The 2006/07 mean data also showed canola hay and silage was higher in digestibility, protein and energy, and lower in fibre, compared to the period 2002-2005 (Table 29).

FeedTest summary data for canola hay and silage for the period 2002 – 2005 is shown in the table below.

Table 29: FeedTest hay and silage data for the period 2002-05

	Digestibility DDM%		Crude Protein CP%		Energy ME MJ/kg		Fibre Neutral Digestive Fibre %	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**
Silage (21 samples)	60.5	44.3-71.4	17.4	6.6 – 25.5	8.8	6.1 – 10.4	46.9	33.3 – 58.2
Hay (79 samples)	59.2	41.7-82.1	13.9	5.5 – 22.9	8.4	3.6-12.1	49.0	26.9 – 68.6

The results from 2006/07 and from 2002-05, illustrate that canola has the potential to make good quality fodder that is high in protein and is similar to good hay in energy value. However, the variation in range (lowest sample recorded to highest sample recorded), also highlights the variability between different crops. Crops that measured at the lower end of the energy range (ie 7.3 ME for silage or 4.1 ME for hay) would not sustain dry stock as a sole ration and should be supplemented with other feeds.

The actual energy content of canola hay or silage is mostly dependent on cutting time. Late cutting times may lead to higher oil content and an increase in energy, but if cutting occurs at a time when plants are stressed (drought affected or frosted), then energy will actually drop with time. While high levels of canola oil in feed is known to reduce stock intake, it is unlikely that frost affected canola cut for hay or silage would have high enough oil for this to occur. More likely, frost affected canola had relatively few mature seeds, leading to lower oil contents.

Buyer satisfaction with canola hay was mixed. Some buyers were very happy while others were disappointed, particularly when buying product that had not been quality tested.

As there can be animal health issues with canola fodders, it is recommended that canola never be fed as a sole ration or fed to very hungry stock.

Lessons learnt in 2006/07……

The following points will be worth remembering if we have to cut canola again for hay or silage.

When baling silage:

Dry Matter:

- Wilt and bale at about 40% dry matter (60% moisture). Note that hay moisture metres are not very good at determining silage dry matter. Baling at drier than 45% dry matter may lead to poor packing, excessive air trapping and dry stalk ends.
- Dry stalk ends cause problems as they can pierce the silage wraps.
- As canola is likely to be high in protein, if baled too wet, it may result in a poor, foul smelling and low palatability silage.

Harvest operations:

- Preferably mow with a roller mower conditioner to smash the stems as much as possible.
- If possible, use a chopper baler to aid packing.
- Canola silage has potentially low water soluble carbohydrate so this means that inoculation with lactic acid forming bacteria would be beneficial for proper ensiling. This is normally sprayed on at the pick-up to ensure a thorough mixing of inoculant with the forage. If spraying on the windrow in front of the baler (not desirable, but better than nothing), don't be too far ahead of the baler as the bugs will die.

Storage:

- Wrap with netwrap rather than twine to hold the stems in, to avoid holing the plastic wrap. Use at least 4 layers over ALL of the bale.
- Be careful when dropping bales onto the ground, especially if in the paddock with stalky stubble. Ideally, cart to the storage site and then wrap.

When baling hay:

Harvest operations:

- Preferably mow with a roller mower conditioner to smash the stems as much as possible (even more important for hay than silage).
- Where the hay has not been aggressively conditioned, the stalks can cause a number of problems. It can be difficult to get the stems dry enough and this can lead to mouldy hay.
- If the material has to be left for a long period to dry the stems, a lot of the leaf material (which is better quality than the stalk and has impacts on palatability) may be lost when raking. In one reported case the dry stalk ends also have been known to cause punctures to the stomach.

- The feed value is in the top 30cm of flower, small pods and the leaves and so excessive raking and even the baling process may lose this.
- Farmer experience this year showed that round bales were easier to make than large squares. Many people also had problems with the dry canola material stuffing into the pre chamber of large square balers.

Sponsors:
FeedTest, Hamilton.

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RESEARCH RELEVANT TO THE RIVERINE PLAINS

Frost damaged crops – lessons from the 2006 season

Author: Phil Newton

Contact No: 02 6030 4500

Organisation: DPI Victoria, Rutherglen

Key messages:

- Frost damage was widespread in 2006 and is likely to become increasingly frequent with the forecast effects of climate change on temperature extremes, rainfall frequency and longer periods of clear dry skies.
- Frosting severity is affected by the process of cooling, the heat transfer properties of the soil, the water content of the atmosphere, the bacterial population in the crop and the atmospheric conditions in and around the canopy.
- Frosting risk is lessened by avoiding low lying areas; using diverse crop types, spreading the time of flowering through variety selection, variable time of sowing and ground cover management.

Aim:

To briefly describe the theory of frosting in crops and how the observations made in 2006 can be related to strategies for reducing the impacts of frosted crops.

How frosts occur:

Advective Frosts

Advective frosts occur when a large cold air mass moves into an area and displaces warmer air, such as when a cold Antarctic air mass moves over the Australian mainland. Advective frosts feature cloud, high winds and freezing conditions either day or night. Crop damage is mainly through wind chill, and there is little that can be done to protect crops from these events.

Radiation Frosts

Radiation frosts are more common during cool seasonal conditions, when radiation energy lost quickly from the ground at night can cause a drop in temperature sufficient to result in a frost. Conditions that contribute to radiation frosts include generally cold weather, no wind, clear skies and low relative topographic position. In a radiation frost, heat loss from the ground surface causes air near the ground to cool, become denser and to flow to low lying areas. Factors that reduce radiation frost events include wind, clouds and higher elevation. Wind causes mixing of air, thereby limiting the impact of cooling at the ground surface. Clouds reduce the loss of heat from the ground by absorbing energy radiated from the ground surface and then re-radiating most of it back to the earth. Higher elevation avoids the pooling of cold air in lower topographic positions. Other factors that can influence the severity of radiant frosts include surface cover, soil type, crop canopy density and moisture content.

White Frosts

Under moist conditions water vapour will condense as dew and then freeze, causing a visible, white frost. White frosts generally cause less damage to plants because the freezing process actually produces heat, and the frost, once formed, acts to insulate the plant from further cooling.

Black Frosts

Under conditions of very low humidity, so called black frosts can occur, when surface frost does not form and plant tissue can freeze, causing significant damage. Surface conditions that let too much heat escape from the ground can make frosts more severe. Heat retained by increased soil moisture, soil clay content/density, or increased radiation absorption due to a due to dark colour can reduce the risk of frosts.

Frost damage to crops

Crop losses are estimated at around $33 million per year in Victoria and SA. Damage occurs mostly when the ice formation occurs within the tissues of the plant.

Some species of bacteria found widely spread in the environment can enhance ice formation. These are called ice nucleation bacteria and have a protein in their outer cellular membrane that triggers ice formation at temperatures ranging from -2 to -15 ^{o}C. This is thought to happen by alignment of water molecules to the shape of the protein, which is similar to the lattice formation of ice. There may be populations of up to 10^6 ice nucleation bacteria per gram of plant tissue.

Some crops are more susceptible to frost than others. For cereals the tolerance to frost decreases from oats to barley to triticale to wheat. Oats are about 4^{o}C more tolerant than wheat, and barley is approximately 2^{o}C more tolerant than wheat.

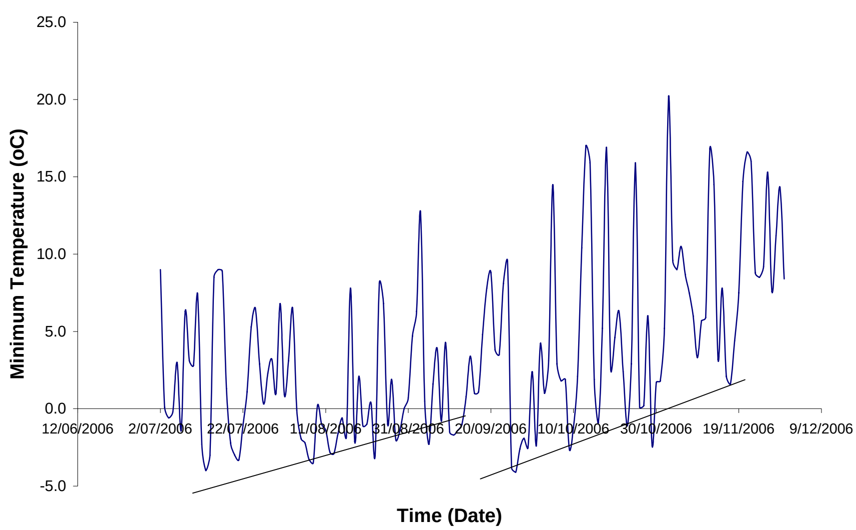

Figure 23. Changes in daily minimum temperature throughout the 2006 growing season at DPI Rutherglen

Wheat crops are the most widely grown cereals and tolerance to frost is greater during the vegetative stages before flowering, when a certain amount of adaptation to the cold occurs. Frost damage to wheat during early stages can appear as whitening and distortion of the leaf extremities, as bent or twisted stems at a node, or as thin irregular heads curling over after flowering. Damage to heads often occurs at flowering, with anthers turning a white colour instead of green/yellow and this generally results in abortion of grains. At the milky dough stage, grains may become bloated with a watery-grey liquid. The amount of damage is finally confirmed when small ‘pinched’ grains mature and are hence downgraded to feed wheat. This may be due to both small size and poor quality (drop in alpha amylase) because sugars were prevented from being turned into starch. Grain usually has a reduced metabolisable energy (ME) level after frosting and elevated protein content.

Management strategies for frost-prone sites

Risk can be spread by sowing crop varieties with variable flowering maturity at different times, as early sown crops of early maturity are most at risk of frost damage. It may also be feasible to sow more frost tolerant crops or grain crops readily made into hay in lower, frost-prone areas. There are greater financial risks establishing high input crops in sites of greater frost risk because the lush tissue growth of these crops is more susceptible to frost damage.

Observations and comments:

During the 2006 growing season minimum temperatures varied between -5 and 15 ^{o}C at Rutherglen (Figure 23). Temperatures dropped below zero on more than 20 occasions, and within -5 ^{o}C at least six separate times from July to grain filling in October. Frosts occurred regularly throughout the booting, heading, flowering and grain filling stages of cereal growth (Figure 23). Lines fitted by eye show a gradual increase in minimum temperatures occurred twice in the growing season (Figure 23).

Wheat grain affected by the combination of frost and dry after anthesis had development interrupted and tended to 'pinch' more at one end of the grain. This affected the ability to fill the endosperm with starch, which effectively reduced its size and caused a narrowing at the damaged end of the grain.

Canola seeds were mostly aborted as the canopy was exposed to frosts by low leaf areas once the seed head had developed. Some remaining seeds were only filled with a watery plant solution and only very low percentages of 'normal' seed were found. Some canola canopies had sufficient water to grow bulk which was harvested for hay.

Lupins aborted seed rather than showing distortion by frost, or grain remained green in the pod. All types of crops were affected by frost in 2006, including lucerne, so there were few management options at the within paddock level other than cutting for hay or direct grazing.

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The economic benefits of precision agriculture: case studies from Australian grain farms

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[3]Queensland Biosciences Precinct, St Lucia, QLD

Key messages:

- Australian grain growers who have adopted precision agriculture (PA) systems that are profitable, are able to recover the initial capital outlay within a few years.
- Farmers see intangible benefits from the use of PA technology.
- The use of, and benefits from, PA technology varies from farm to farm, in line with farmer preferences and circumstances.

February 2007

Executive summary:
In commercial practice in Australia the implementation of precision agriculture (PA) has in common the use of spatially-aware technologies made possible through the use of global positioning systems (GPS). Most commonly this technology is applied in: vehicle guidance (to reduce overlap in application of agricultural chemicals), reduced traffic associated with tramlining (reduces compaction and operator fatigue), shielded spraying of pesticides in row crops, yield monitoring, variable rate technology (VRT) (for application of agricultural chemicals and especially fertiliser), and within-paddock zone management for agricultural operations.

Although PA technology has been available in Australia for more than a decade, it has been estimated that only around 3% of Australian grain growers are using some form of the technology (Price, 2004). One of the chief reasons for low adoption of PA is the reluctance of farmers to invest many thousands of dollars in PA without knowing if the technology will return a profit. A number of studies have reported the economic benefits of tramline farming and guidance for chemical application. Few studies have examined the value of variable rate technology and zone management

In this study we attempt to quantify the economic benefits of PA on six case study farms from the Australian wheatbelt. We did not confine our analysis to VRT alone but also considered benefits to guidance and reduced traffic.

The farm case studies covered a range of agro-climatic regions (Mediterranean, uniform and summer dominant rainfall patterns) and cropping systems (wheat-lupin, wheat-canola, and winter and summer crops). Farm sizes varied (1,250 to 5,800 ha cropping program), as did soil types (shallow gravels to deep cracking clays), and production levels (average wheat yields from 1.8 to 3.5 t/ha). The farmers had been involved in PA from 2 to 10 years and covered the range of PA technologies that are commonly used by Australian grain farmers. Among the six farmers, all had invested in guidance and were practising some form of variable rate management of fertiliser. However, only some were using autosteer and tramlining. One was using NDVI and another the GreenSeeker technology for in-season nitrogen management. As such, the data set covered the range of likely situations confronting practitioners of PA in the Australian wheatbelt.

Each grower was interviewed and information was collected on: the size and type of cropping program, area of the cropping program where PA technologies were applied, average cropping gross margin, and price of PA equipment purchased (and date purchased). Also investigated were: management actions associated with implementing PA technology, the estimated reduction in overlap (for tramlining/guidance), the rates of fertiliser applied in each zone (for zone management), rates of fertiliser applied for uniform zone management, yield in each management zone and growers' opinion of non-monetary benefits of PA. Standard economic analyses were applied including gross margins and discounted cash flow analysis.

The level of capital investment in PA varied from \$55,000 to \$189,000, which is typically at the medium to high end of investment. When expressed as investment per hectare cropped it varied by a factor of three from \$14 to \$44/ha. The estimated annual benefits from PA ranged from \$14 to \$30/ha and consequently the investment analysis showed that the initial capital outlay was recovered within 2-5 years of the outlay, and in four out of the six cases within 2-3 years. The gross margin benefits were well in excess of the typical increases required to yield a break even on the investment.

For all farmers we were able to quantify benefits to variable rate fertiliser management, ranging from \$1 to \$22/ha across the six farms. On a per paddock basis, benefits ranged from -\$28 to +\$57/ha/year. Variation from farm to farm could be explained by (1) whether or not starter fertiliser was being varied and not just nitrogen topdressing, and (2) the degree of within-paddock yield variation. The methodology for estimating the benefits of VRT requires further testing on paddock-scale data where yields and fertiliser rates are recorded for uniform and VRT-managed strips.

Benefits due to reduced overlap of spraying were typically in the order of 10% savings. Other benefits nominated by farmers and estimated by us were less fuel use, less soil compaction, less hired labour requirement and more timely sowing. Intangible benefits listed by farmers were: the ability to conduct on-farm trials, increased knowledge of paddock variability, increased confidence in varying fertiliser rates, and better in-crop weed control due to shielded spraying.

All farmers were all highly literate in the use of computers, GPS technology, and variable rate controllers, routinely soil tested and kept good farm records. All invested considerable time in setting up their system in the beginning (with considerable teething problems in some cases), but on-going labour demands were minimal. Some did not use a consultant, while others placed heavy reliance on consultants for zone definition, yield map processing and variable rate map production. We also found that, while a number of farmers are trialling VRT in test strips within paddocks, it seems that very few have taken the jump into full commercial implementation of VRT on their farms.

This study is the first of its kind to estimate the economic benefits of precision agriculture in a commercial context. It demonstrates that Australian grain growers have adopted systems that are profitable, are able to recover the initial capital outlay within a few years, and also see intangible benefits from the use of the technology. While the results here will go some way towards informing the debate about the profitability of PA, it also illustrates that the use of, and benefits from, PA technology varies from farm to farm, in line with farmer preferences and circumstances.

Acknowledgements:
This work has been carried out with funding from the Grains Research and Development Corporation and CSIRO Sustainable Ecosystems. The authors would like to acknowledge the time and access to farm records from David Forrester, David Fulwood, Stuart McAlpine, Mike Smith, Rupert McLaren and Richard Heath. Assistance from Ian Maling (SilverFox Solutions, Perth) for data analysis of yield maps and Bindi Isbister (Western Australia Department of Agriculture and Food, Geraldton) is gratefully acknowledged.

Annual ryegrass resistance to glyphosate in southern NSW

Authors: Melissa Quinn and Ken Young

Contact No: 03 5833 9251

Organisation: University of Melbourne

Key messages:

- There is a strong indication that glyphosate resistance is present in up to 40% of paddocks in the Riverine Plains.
- Paddocks with a high rating for resistance had up to 20 years consecutive glyphosate use.
- Paddocks with low levels of resistance has either been in pasture or had breaks from glyphosate use.

Aim:

To determine the level of annual ryegrass glyphosate (ARG) resistance in cropping paddocks of southern NSW.

Method:

ARG weed seeds were collected from 35 cereal crops in a region in southern New South Wales between Moama and Mathoura in November 2005. These ARG seeds were grown in punnets and varying rates of the glyphosate was applied at the 2-3 leaf stage to determine if levels of resistance were present. Each paddock had 4 treatments: control (C), half the registered rate (H), full registered rate (F) and double the registered rate (D), with 5 replications. After 21 days the punnets were visually assessed, each punnet was rated from 1 to 5, 1 being completely yellow or dead and 5 being green with no sign of senescence.

Results:

No paddocks had a 100% kill (rating 1), regardless of the rate applied. Applying double the rate achieved at least a partial kill in all paddocks, with 54% of paddocks having a rating of 3 (plant wilting leaves half green/yellow), 21 days after application. There was no significant difference between the half rate and the normal rate.

Table 30: The mean annual ryegrass efficacy rating score of 35 paddocks applied with different rates of glyphosate assessed 21 days after application

	Mean % of plants in each category			
	Untreated	Half Rate (350 mL/ha)	Normal Rate (700 mL/ha)	Double Rate (1400 mL/ha)
1 - Completely yellow	0	0	0	0
2 – Majority of plant yellowed and wilted	0	6	0	46
3 – Plant wilting leaves half green/yellow	0	34	37	54
4 – Leaf tips beginning to yellow otherwise green/turgid	0	54	60	0
5 – Completely Green and erect	100	6	3	0

There were differences between cereal paddocks, with some paddocks (6 out of 35) that maintained a high survival score (i.e. rating of >4.5) until a double rate of glyphosate was used. These paddocks then scored a rating of 3.

Observations and comments:

Unfortunately we did not grow the plants through to maturity to see if they would produce seed. We are following these seed batches through in another experiment conducted in 2007.

Comparison of biological farming versus conventional farming in relation to mycorhizal associations and crop yield

Authors: Tim Pohlner and Ken Young

Contact No: 03 5833 9251

Organisation: University of Melbourne

Location: Devenish
Growing Season Rainfall:
Annual: 208 mm
GSR: 132 mm
Soil:
Type: red loam
pH (H_2O): 6.3
Sowing Information:
Sowing date: 27/6/06
Paddock History:
2006 – Barley
2005 – Triticale
2004 – Wheat
Replicates: 15

Key messages:

- The biological system improved plant density on the low EM zone area.
- VAM was observed in both conventional and biological systems, though levels were higher in the biological treatment in the medium and high EM zones.
- Yield was not significantly different between the biological or conventional systems in 2006.

Aim:
To evaluate the effectiveness of the Lawrie Co Soil & Crop Nutrition Program for Broadacre Wheat Cropping in terms of phosphorus availability, VAM inoculation and yield.

Method:
A paddock was split into two sections. One section had the biological program applied and the other received a ‘conventional’ fertiliser program. The biological program used seed treated with VAM and Neem Oil, and at seeding had Stabilised Boron Humate Granules applied at 9 kg/ha, Zinc Sulphate Monohydrate Granules at 3 kg/ha and Sulphate of Ammonia at 45 kg/ha. The conventional program used Baudin barley treated with Baytan, which was sown at 95 kg/ha along with 125 /kg/ha MAP. Both systems had the same pre and post sowing herbicide applied. Prior to application of the treatments the paddock had an EM38 conducted and zoned in to low, medium and high EM areas.

Results:
Analysis of the trial aimed to determine whether the biological treatment improved available phosphorus levels, through untying phosphorus normally unavailable under conventional growing systems. Soil Olsen P from both treatments were examined pre germination and post grain fill, revealing that there was no significant difference in phosphorus levels between treatments (except for the pre germination Olsen P for the low EM zone). With comparable results from total plant phosphorus, this indicates that the biological growth system achieved little in regards to mineralising tied up nutrients in 2006. This conclusion was unexpected due to the presence of VAM fungal association being clearly present.

There were some significant ($P<0.05$) differences between the biological and conventional treatments for some tests (Table 31) however these weren’t consistent across all EM zones. The medium and high zones had significantly higher VAM rates in the biological system compared to the conventional system, however this wasn’t significant in the low EM zone. Plant density was significantly better for the biological treatment in the low and high EM zone, but not in the medium EM zone. There were no significant differences between treatments for total plant P, Olsen P post grain fill or for grain yield.

Table 31: Biological and conventional treatment results

Plant Density (plants/ m²)				
EM zone	Bio mean	Con mean	P(T<=t) two	Significant difference
Low	176	148.4	0.0002	yes
Med	130.2	140	0.121302	no
High	150	134.6	0.0032	yes
All	152.067	141	0.0087	yes

Total Plant Phosphorus (mgP /g plant)				
EM zone	Biological	Conventional	P(T<=t) two	Significant difference
Low	1741.25	1748.75	0.986747	no
Med	1845	1670	0.5882	no
High	229	1867	8.68	no
All	1238.214	1762.857	0.078	no

Tiller Count (tillers/ m²)				
EM zone	Biological	Conventional	P(T<=t) two	Significant difference
Low	457.7	354.4	0.0004	yes
Med	468.7	464.4	0.792	no
High	460.8	436.8	8.68	no
All	462.4	456.1667	0.5442	no

VAM Fungi Identification Score (1- no VAM, 5 – Total VAM)				
EM zone	Biological	Conventional	P(T<=t) two	Significant difference
Low	2.6	1.8	0.006	yes
Med	2.9	1.6	0.00006	yes
High	2.9	1.5	0.00053	yes
All	2.7	1.6	0.00004	yes

Olsen P - pre germination				
EM zone	Biological	Conventional	P(T<=t) two	Significant difference
Low	9.45	12.35	0.0438	yes
Med	15.0	13.65	0.3228	no
High	8.35	13.65	0.25	no
All	11.4167	11.45	0.974	no

Olsen P - post grain fill				
EM zone	Biological	Conventional	P(T<=t) two	Significant difference
Low	21.4	19.75	0.057	no
Med	16.1	18.05	0.747	no
High	12.75	13.05	n/a	no
All	16.75	16.95	0.889	no

Yield (t/ha)				
	Biological	Conventional		Significant difference
	0.43	0.46		no

Sponsors:
Riverine Plains Inc.

The effect of light quality on weed germination

Authors: Alistair Watts and Ken Young

Contact No: 03 5833 9251

Organisation: University of Melbourne

Key message:

- Changing the ratio of red and far red light at time of sowing may influence the rate and timing of weed emergence.

Aim:
To investigate the effect of manipulating light quality on weed emergence at sowing.

Introduction:
Light is composed of many different wavelengths that are essentially represented by the colours of the rainbow. Of particular importance to germinating plants are the red and far red wavelengths of light, which are known to either inhibit, or encourage seed germination depending on whether they are light loving or shade loving plants. A bright, sunny environment is rich in red light, while far red light is abundant in shady environments. It is thought that light loving plants, like ryegrass, detect high levels of far red light to avoid germinating in shady environments where they might be out-competed by more specialised plants. This experiment aims to test this hypothesis.

Method:
Four red (R) / far red (FR) ratios were used in the experiment, being created through the use of cellophane covered boxes. The boxes were covered with either red (R/FR ratio 0.9:1.0), green (R/RF ratio 0.43:1.0) or red and green (R/FR ratio 0.2:1.0) cellophane, or were left uncovered (R/FR ratio 1.2:1.0). The boxes were only left on the plots during a cultivation event. Emergence of ryegrass numbers were then recorded over the next 6 weeks. Prior to cultivation soil cores were taken from each plot to estimate ryegrass seed bank numbers. Statistical analysis using both an ANOVA and an ANCOVA were conducted on cumulative ryegrass emergence.

Results:
There was no significant difference between treatments ($P = 0.494$) on ryegrass emergence when just the emergence figures and light boxes were considered. However, the ANCOVA (which also considered the existing ryegrass seedbank levels under each box), showed that the lower R/FR ratios, (i.e. those with a higher level of far red light) had significantly higher emergence ($P<0.05$) than the other treatments. This was contrary to what was expected. Possible explanations for the plant germination results include: environmental variables related to the dry season, the late sowing (which may have caused plants to respond to increased levels of FR light), lower soil moisture, higher temperatures and low natural sunlight affecting wavelength produced by the treatments.

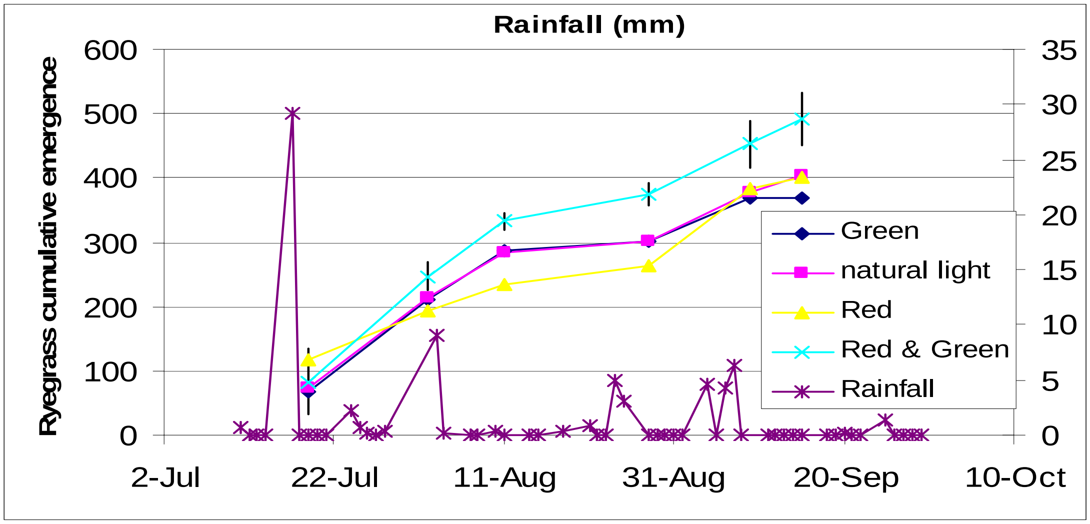


Figure 24. The effect of R/FR ratio filters on ryegrass numbers when seedbank numbers are used in a covariate (P<0.05)

Observations and comments:

While this experiment did not show a linear relationship between enhanced germination and altered light quality, the usefulness of this technique warrants further investigation to determine if the effect is stronger at different times of the year, under better soil moisture conditions and with different weed species. This will be examined in 2007.

Insert full page NAB ad

Guidelines to developing a robust leasing or share farming system

Author: Liam Lenaghan

Contact No: 03 5382 7880

Organisation: John Stuchbery & Associates, Donald

Key messages:
- Negotiated and executed properly, leases (including flexible rain-based leases) and share farm arrangements have the ability to generate profit and wealth for farm businesses and landowners alike without jeopardising business survival.
- Some step by step guidelines to planning and executing a lease or share farm agreement are provided.

To ensure a desirable outcome, thorough planning and negotiation should be conducted prior to entering into a leasing or share farming agreement.

The following matters may significantly impact upon your ability to acquire and successfully profit from a lease or share farm arrangement. Each matter should be given due consideration.

1. Profitability
Determine as accurately as possible the profitability of the venture. To do this budgeting will be essential.

Be realistic about the likely costs and returns and allow considerable margin for error or unforeseen events/costs. If leasing, values must be tied to earning potential not market sentiment.

If the venture does not return profits, then the purpose of the venture must be questioned!

2. Cash flow
When are outgoings and income anticipated?

Lease payments are usually in advance and in lumpy instalments. This can have a major impact on cash flow.

Under share farming arrangements payments to the land owner are not made until the crop proceeds are received.

3. Risk / volatility
The level of risk exposure must be clearly determined. Consider all the risks associated with the venture: seasonal / climatic variability; production risk; commodity price; management risk; finance and business risk.

For each risk, analyse who assumes the risk (landowner, farmer, both?), the size of the risk, the likelihood of the event occurring and the impact that it would have were it to eventuate.

Determine the level of reward you require to justify assuming the risks.

4. Sensitivity analysis
Run scenarios and ask the 'what if…?' questions. Test the impact of a range of seasons, lease values, share proportions, yield outcomes etc. This can be done easily and accurately if the initial budget is prepared correctly.

5. Tenure
Share farming and lease agreements are generally established on a 12 month and 3 year tenure respectively. Such timeframes are insufficient to plan and successfully execute a low-risk, profitable business plan.

Aim for a minimum of a 5 year agreement or at the least a 3 year period with an option of a further 3 years.

The benefits will be present for the landowner too! They will receive increased security through a longer agreement and their asset will inevitably be returned in better condition as the longer the tenure the greater the incentive for the tenant to maintain and improve the farm assets.

6. Lease / share farming reviews
Ensure that the agreement has the capacity to review the particulars of the lease or share agreement at pre-determined intervals. The relevance of this increases as longer tenure periods are negotiated.

Determine whether adjustment for improvement to capital values can be taken into account. This will provide incentive and reward for the farmer to improve the value of the landowner's asset.

7. Capacity to succeed
Conduct a skills audit of your business. Do you possess the necessary management expertise, machinery capacity, labour and time to expand? If not, are you able to readily acquire them?

When negotiating or presenting an application to enter into an agreement present the findings of the skills audit. Landowners will view favourably the fact that you have proven management skills, modern plant or sufficient capacity to increase your business's operations, a management plan for their property, access to well regarded advisers etc.

8. Impact of operating restrictions
Request that all operating restrictions are articulated before entering into an agreement. Often limits are imposed on cropped areas, proportion of crop types, certain herbicide usage etc. Assess the impact that such restriction will have on your businesses ability to make the venture profitable and reflect this in the lease value or share proportion. The more restrictive the agreement is, the more difficult it will be to generate sustained profits.

9. Water
Accessibility, reliability and quality of water is paramount - now more than ever before! Is there sufficient water to conduct a livestock enterprise? Is water suitable for herbicide application? What is the cost of sourcing alternative water supplies and who bears that cost?

10. Taxation implications
These are usually of greater importance to the landowner, but investigate the implications of changes upon your businesses primary production status and subsequent tax matters.

11. Exit strategy
Discuss the notice, costs, penalties and/or compensation owing to each party if for any given reason the agreement can not reach maturity.

12. Communication
When all else fails……….

Consider the alternatives to buying or selling agricultural land

Author: Liam Lenaghan

Contact No: 03 827990

Organisation: John Stuchbery & Associates, Donald

Key messages:

I can't change the direction of the wind. But I can adjust my sails. Anon

- Historically, Australian farmers own the land they farm. Given that a large capital cost is associated with land purchase, businesses may seek non-ownership options.
- Alternatives to buying or selling agricultural land do exist.
- Leasing and share farming agreements are the most commonly utilised alternatives in Australia but still play a relatively minor role.
- Other models also exist and need consideration.
- Negotiated and executed properly such arrangements have the ability to generate profit and wealth for farm businesses and landowners alike without jeopardising business survival.
- In order to create wider scale adoption and success of non-ownership models two key issues need addressing:
  1. Education of investors in rural property that their returns will be affected by seasonal conditions (retired farmers are often the worst offenders), and
  2. The duration of lease and share farm agreements must be increased to a minimum of 5 years to allow a low-risk, profitable farm business plan to be executed.

Introduction:

Purchasing land represents a large capital cost. Not all businesses who wish, or need to initiate growth, can sustain this cost. Conversely, for those moving on from farming, relinquishing ownership of the land asset may not be the best option either.

Alternatives to ownership changes do exist and must be considered. The two obvious models being leasing and share farming. Clearly, leasing and share farming are not new concepts but in Australian agriculture they play a minor role with only 6% of total farm land area being under such arrangements compared to 35% in the United Kingdom and almost 50% in the USA (Ashby 2003).

This paper compares the weaknesses and strengths of common non-ownership options and proposes an alternative to the norm. Some step by step guidelines to planning and executing a lease or share farm agreement are also provided.

Comparison of current arrangements

Leasing

Typical characteristics of a lease arrangement are:

- The lease rate is a fixed sum.
- Lease payments are generally in advance in 'lumpy' installments.
- The period is pre-determined, usually 3 years.
- The farmer assumes full management and decision making control.
- The farmer assumes all the seasonal, production and commodity risk.
- The landowner relinquishes control (except for restrictions that may have been enforced through the lease agreement).
- The landowner assumes no seasonal, production or commodity risk but does share a proportion of the farmer's business risk.
- The landowner has a fixed, predetermined income.
- The landowner loses primary production status from a taxation view point.

The result of this current lease methodology is that regardless of the season or the level of production, one party will be forgoing opportunity. In good seasons the lessee will make a far greater return than the landowner, and vice versa in poor seasons.

Traditionally, lease values have been established in cropping situations as 5-8% of the land's purchase value.

In recent years lease values have moved above this range. For example, the average land price achieved during 2004 and 2005 in the Horsham municipality was $2632/ha ($1065/acre) (PRISM, Department of Sustainability and Environment). The expected lease range at 5-8% of land value would therefore be $130-210/ha ($53-85/acre). Actual values achieved during this same period were $185-235/ha ($75-95/acre) so growers have effectively been valuing lease land at 7-9% of land value.

It is difficult to see lease values sustaining these levels given the recent and significant rise in crop production costs (particularly fuel, fertilisers, labour and freight) and poor farm business performance as a result of dry seasons.

Under a lease arrangement the farmer assumes all the risk and supplies all the management, machinery, labour and inputs. The returns must justify the exposure!

Share farming

The typical characteristics of a traditional share farm arrangement are:

- The sharefarmer and landowner share the expenses and proceeds of the crop in agreed proportions depending on each party's contribution.
- Long-term security is generally not present for the share farmer
- The sharefarmer makes no payments to the land owner until crop proceeds are available and the payments made are in proportion to the total proceeds.
- The landowner generally accepts a lower return on investment than if the owner operated the land themselves (not always the case depending on scale and management factors).
- The landowner's income is at the mercy of both the season and the skill of the sharefarmer (both production and marketing skill).
- The landowner will generally retain primary production status for taxation purposes provided their involvement in the business is more than a passive one (payment of expenses relating to ownership of land is not sufficient).

The biggest limitation to this type of arrangement for many landowners is the potential requirement to provide working capital. Furthermore, the return the landowner receives on their investment in land and inputs is also subject to the skill of the grain grower – this can be another unquantifiable risk!

The advantage for the grain grower is a lower capital requirement (no lease owing) and limited expenditure on inputs (shared with owner) thus reducing the size of the loss in poor seasons. There are also cash flow advantages in share farming as opposed to leasing.

Table 32 details the contributions from both the sharefarmer and landowner in common share farming splits. Obviously there are a multitude of variations dependent upon the contribution of each party and the perceived risks involved.

Table 32: Typical income split and contributions from both parties involved in share farming arrangements

Income Split (sharefarmer : landowner)	Sharefarmer contribution	Landowner contribution
70 : 30 Cereals only – higher risk environments	Machinery Labour All inputs	Land only
80 : 20 Pulses & canola – higher risk environments	Machinery Labour All inputs	Land only
60 : 40 Higher risk environments	Machinery Labour 50% inputs	Land 50% inputs
50 : 50 Lower risk environments	Machinery Labour 50% inputs	Land 50% inputs (Lime/gypsum if required)

An alternative mechanism to share risks and spoils

There are inequities and risks for both the land owner and the lessee / share farmer under current arrangements that potentially act as a barrier to wider adoption of tenant farming. An alternative is a flexible rain-based lease arrangement that addresses these inequities.

The concept involves a paradigm shift away from leasing land to leasing rainfall, given that rainfall is the primary limitation to crop yield and subsequently to farm business performance.

Under the proposed flexible rain-based lease arrangement, the following occurs:

- The land owner accepts a proportion of the seasonal risk - a reality of making an investment in agriculture! This is a feature of current share farming agreements but not lease arrangements.
- The grain grower accepts only a proportion of the seasonal risk!
- The land owner has no exposure to the management risk. Exposure to the farmer's management skill is a potential weakness of current share farm arrangements.
- The grain grower accepts all the management risk. If the farmer has exceptional management skills why should the land owner derive monetary gain? The share farmer does not gain financial reward from any capital appreciation he creates in the land owner's asset!
- A floor and ceiling value should be negotiated to protect both parties in the event of an exceptional circumstance in weather.

This system revolves around pricing the rainfall correctly, getting the management right and sharing the spoils! Theoretically, and within reason, the more it rains the greater the yields and profits and the greater the ability of the business to pay for land access. Conversely, in low rainfall seasons when crop yields, profitability and the ability to pay for land access is reduced, so too are lease payments.

The success of the agreement for the landowner therefore revolves around the ability to capture additional income in above average seasons. Whilst for the grain grower, the success revolves primarily around their ability as a manager to convert rainfall into grain.

By way of explanation, I shall use the Horsham district lease example again. Horsham's long term average annual rainfall is 450mm and it long term average growing season rainfall (GSR) is 320mm. In its simplest form, valuing lease land on rainfall, concentrates on growing season rainfall (although more complicated, it is possible to put a value on the contribution that non-GSR rainfall makes to crop performance).

I have valued GSR at $0.54/mm/ha. This is a theoretical value used by way of example not a recommended value! It is both possible and sensible to establish a rainfall price matrix which takes into account other factors such as commodity price outlook, crop type suitability etc.

Table 33: An example of the impact of growing season rainfall on lease prices under a flexible lease agreement when GSR is valued at $0.54/mm/ha.

Decile	Rainfall (mm)	Lease value	
		$/ha	$/ac
3	147	79.4	32.10
5	320	172.8	70
8	464	250.6	101.4

An analysis of returns to both the landowner and grain grower is presented for three land access scenarios – a 50:50 sharefarm arrangement, a fixed lease agreement and a flexible, rain-based lease agreement (Table 34).

By introducing a flexible, rain-based lease agreement the benefits to each are:

To the grain grower:

- The cost of land access is proportional to rainfall and the business's ability to pay.
- Minimises the impact of poor seasons at the expense of the landowner - this is an opportunity cost to the landowner not a cash expense!
- Shares the spoils in good seasons.

To the landowner:

- The opportunity to capture additional profits in good seasons.
- No working capital requirement.
- No exposure to the grain grower's management skill.

The trade-off for the landowner is that returns will be poorer in dry seasons however never negative as can be the case in a share farm arrangement.

The actual figure paid for rainfall should be influenced by secondary drivers of production and profitability such as weed pressure, disease potential, commodity outlook etc.

In order for such agreements to become a reality it will be necessary to re-educate investors in rural property that their returns will be affected by seasonal conditions.

Concluding remarks:

Alternatives to buying or selling agricultural land do exist for businesses wishing to remain and expand as well as those seeking to move on and pursue other interests.

The two most utilised alternatives to land ownership changes are leasing and share farming agreements. Whilst they are common concepts, they play a relatively minor role within Australian agriculture.

Other models also exist and need consideration.

Negotiated and executed properly such arrangements have the ability to generate profit and wealth for farm businesses and landowners alike without jeopardising business survival.

Two key issues that need addressing in order that progress is made are:

1. Education, or re-education, of investors in rural property that their returns will be affected by seasonal conditions (retired farmers are often the worst offenders), and

2. The duration of lease and share farm agreements must be increased to a minimum of 5 years to allow a low-risk, profitable farm business plan to be executed.

References:

Ashby, RG. Successful land leasing in Australia: A guide for farmers and their advisers. RIRDC (2003).

Table 34: An analysis of returns for both the land owner and grain grower under three different land access agreements

	Sharefarm (Typical 50:50 split)						Fixed lease ($173/ha or $70/ac)						Variable lease ($0.54/mm/ha)					
Decile	3		5		8		3		5		8		3		5		8	
Who?	LO	GG	LO	GG	LO	GG	LO	GG	LO	GG	LO	GG	LO	GG	LO	GG	LO	GG
Income ($/ha)	80	80	322	322	524	524	-	160	-	644	-	1048	-	160	-	644	-	1048
Machinery/Labour($/ha)	-	55	-	60	-	70	-	55	-	60	-	70	-	55	-	60	-	70
Inputs ($/ha)	46	46	60	60	81	81	-	92	-	120	-	162	-	92	-	120	-	162
Gross Margin ($/ha)	34	-21	262	202	443	373	-	13	-	464	-	816	-	13	-	464	-	816
Lease ($/ha)	-	-	-	-	-	-	-	173	-	173	-	173	-	79.	-	173	-	251
Surplus ($/ha)	**34**	**-21**	**262**	**202**	**443**	**373**	**173**	**-160**	**173**	**291**	**173**	**643**	**79.4**	**-66**	**173**	**291**	**250**	**565**

LO = landowner GG = grain grower

It pays to prepare with on farm storage

Author: Peter Botta

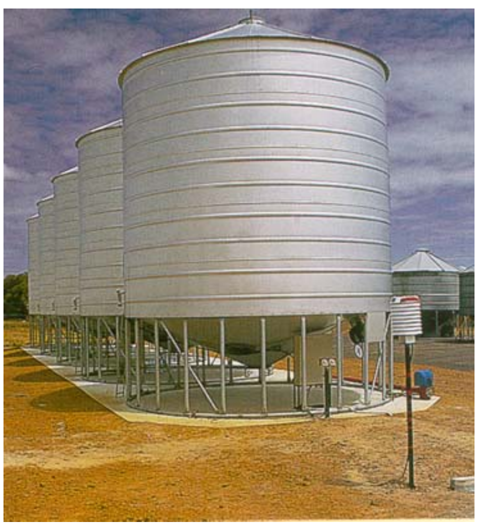
Contact No: 03 5761 1611

Organisation: DPI Victoria, Benalla

Plan for profit:
Increasingly, grain growers are storing grain in the hope of improving the overall price that they receive. Once a grower decides to market their grain they face a whole new ballgame. To ensure success, the need for careful planning is essential. Grain insects, end-user requirements, maintaining quality and contracts are a few of the issues at hand.

The most important thing to do is to understand the markets you wish to supply and their requirements. All of this takes careful planning and may mean improving or increasing storage facilities. Markets are increasingly demanding grain free of chemical residues. In sealed storage, grain can be fumigated effectively, providing quick, inexpensive and long lasting insect control without the problem of pesticide residues.

Keep it clean:



Prevention is better than cure. **It is easier and better to prevent an infestation than to treat an existing one.** Any grain spills should be cleaned up immediately wherever they may be but particularly around the storage area. To help cleaning up, spray out or remove any weeds around the storage area. Silos mounted on a slab are easier to clean and keep clean.

Plan your storage area to ensure easy access and use.

Once storage structures and handling equipment have been cleaned they should be treated with a structural treatment. Dryacide® can be used to treat storage and handling equipment for residual control. Dryacide® can be applied as either a dust or a slurry and is widely used by bulk handling authorities as a surface treatment for storage facilities. The slurry should be applied to the point of run-off and the dust applied to give a thin coating to the treated surface. Always read and follow label directions.

Identify your markets:
Identify your markets to ensure only acceptable grain treatments are used. Generally, grain to be stored for more than six weeks should be treated. Grain can be treated with a protectant when it is added to storage or fumigated in a sealed silo. Most contact protectants give between 3 and 6 months protection. This period is dependent upon the moisture content and temperature of the grain. Too high a moisture content and temperature can lead to the rapid breakdown of

protectants and leave grain vulnerable to attack. Always aim to store grain at a moisture content of 12% or less and at a temperature of 25^{o} C or less. This will also help to limit the activity of insects and avoid grain spoilage from moulds and fungi.

When using protectants always read and follow label directions, calibrate, mix and apply chemicals correctly and always wear the recommended safety gear.

Maintaining quality:
High moisture and temperature can affect grain in many ways. Insects are more active, spoilage can occur due to moulds and fungi and seed viability can be affected. Always aim to store grain at a moisture content of 12% and at 25 ^{o}C or less. Harvest temperatures are often 30^{o}C, and in summer, temperatures in silos can exceed 40^{o}C. So how can you keep grain cool?. With existing galvanised silos a coat of white paint will go a long way to keeping temperatures down. The more brilliant white the paint is the more reflective it will be. If you are buying a new silo ask that they be made of zincalume or colorbond.

When harvesting, target cool grain to be stored on-farm. This may mean harvesting when moisture can be high, a moisture meter can be used to ensure moisture limits are not exceeded. Installing an aeration system will further assist in cooling grain.

Grain should be regularly monitored to detect any problems which may arise. Early detection of insects prevents numbers building up and potential reinfestation of other sites. Inspect storages fortnightly in Summer and monthly in winter. Insects are not evenly distributed in a silo. They seek out the most favourable places, such as the grain peak, and around any hatches where moisture can get in.

Be sure with sealed storage:

In a sealed silo, grain can be fumigated effectively providing quick, inexpensive and long lasting insect control. Market flexibility is greatly enhanced because grain is stored residue-free.

When considering new storage then sealed storage should be seriously considered.

Like any piece of equipment on the farm sealed silos need to be well maintained to work. Seals should be checked before each filling and replaced if worn or damaged. Always pressure test the silo to see that it is sealed.

Ideally, grain should be stored in sealed storage and fumigated with **Phosphine.** Grain treated with phosphine in sealed storage gives you greater marketing flexibility, and less hassle to treat at harvest compared to applying contact treatments. Depending on the formulation used (tablets or blankets), the complete fumigation process (including withholding and aeration period) can take up to 25 days. Phosphine is not a quick fix solution and will only be effective if given the time it requires to work.

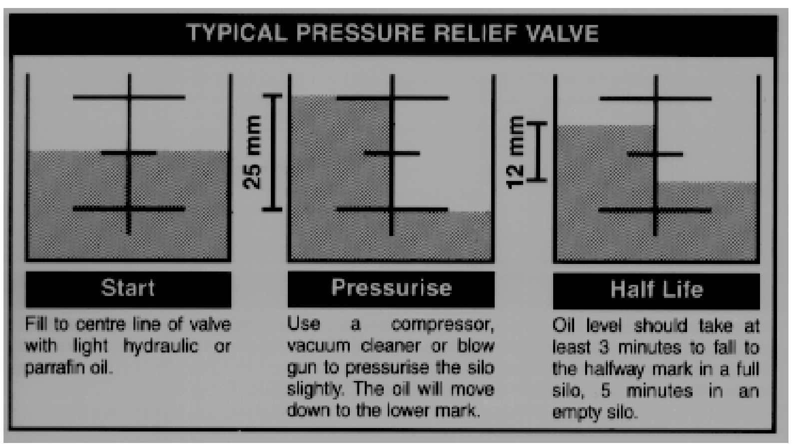
To use phosphine, carbon dioxide or nitrogen successfully, a sealed silo must be used. When using these gases, the area being fumigated must be able to hold a concentration of gas for a length of time. In unsealed structures these requirements are not met, even if the dose rate is increased. At best adult insects may be killed, but if pupae or eggs are present it is unlikely all will be killed. These will continue to develop into adults to reinfest the grain. If left unchecked can do a lot of damage to the grain.

In the longer term, sub-lethal doses of fumigant provide conditions in which grain insects will increase their level of resistance to phosphine. Eventually using phosphine in unsealed storages will become completely ineffective.

A sealed silo should be pressure tested before use to ensure it is suitably sealed. The pressure relief valve is used as a gauge for pressure testing. Always follow manufactures instructions on how to pressure test your sealed silo.

Fumigate immediately the silo has been filled or new grain is added. Place tablets on trays on the grain surface, removing prior to outloading. Prepackaged phosphine (ie blanket/chain type formulations) can be placed on top of the grain or hung in the headspace. Remove these before outloading.

Sealed silos should be checked yearly to ensure that they are able to meet a standard pressure test. Check for any perishing or damage to seals or to sealant material. Replace any worn seals and repair any damage. Pressure test the silo to test that it is gastight.



Fumigate the silo as per label directions, and take advantage of the marketing flexibility and potential available through storing residue-free grain of a high quality.

Does it pay to store grain on farm?

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In Brief
Grain storage is one way to manage price risk and harvest logistics. The costs of storage must be outweighed by the benefits for grain storage to pay. This paper looks at future investment into grain storage from a grain producer's perspective. It examines the costs and benefits of grain storage and whether it pays to store grain. Three grain storage systems including grain storage bags, sealed silos and warehousing are examined.

Grain storage bags

Grain storage bags are relatively new technology offering a low cost alternative for temporary storage of grain to permanent grain storage structures on farm such as silos. Grain storage bags are made of multilayer polyethylene material similar to that used in silage fodder systems. Bags typically store between 200 and 220 tonnes of wheat and are filled and emptied using specialised machinery. A different machine is required for the inloading and the outloading operation. Typically an inloading machine is purchased and outloading, which is not as time sensitive, is contracted. The bags are sealed after filling producing a relatively airtight environment which, under favourable storage conditions, protects grain from insect damage without the use of insecticides.

Sealed grain silos

Sealed silos offer a more permanent grain storage option than grain storage bags. Depending on the amount of storage required, they will have a higher initial capital cost than grain storage bags and are depreciated over a longer time frame than the machinery required for the grain bags. In a silo grain storage system as stored tonnage increases the capital cost of storage increases.

Warehousing

Warehousing provides an opportunity to store grain in bulk receival sites off-farm. There is no capital or overhead costs to the grower using this storage system. Capital and overhead costs are borne by the warehouse service provider.

Costing grain storage systems

The cost of grain storage systems will be influenced by a range of factors including:

- Tonnage to be stored.
- Locality and proximity to a central receival grain site.
- Owner or contract harvesting.
- Owner or contract freight.
- Owner or contract loading and/or outturn harvest bag machinery.
- Site preparation, including grading and fencing.
- Risk of quality loss and down-grading.
- Management of storage bags, including insect control (if required).

The costs of storage

There are several components to grain storage costs:

- Capital costs including annual interest on the capital equipment and depreciation.
- Other overhead costs.
- Variable costs.
- Opportunity cost - grain sales foregone.

Cost comparison

A comparative cost analysis of grain bag, sealed silo and warehouse storage systems is presented in Table 35 to demonstrate the difference in variable costs and capital and overhead costs between different storage systems. The analysis represents the costs for each year when grain is stored assuming grain is stored every year. The analysis assumes that there will be no drop in quality of grain on farm and that grain will be delivered to a local bulk receival site either at harvest in the case of warehoused storage or in July in the case of grain storage bag and silo systems. Grain sales occur in July of the storage years.

A number of assumptions have been made in the analysis. These assumptions are outlined in Table 37.

Table 35 presents the costs and benefits of different storage systems (excluding any price benefit) in each year of storage where 500 tonnes of grain is stored from December to July. The grain storage bag system assumes the purchase of a grain bagging machine for in-loading and contract use for out-loading.

Average costs where storage occurs in seven of ten years

Where storage occurs in seven out of every ten years and costs are averaged over a ten year period the costs of storage will differ to those presented in Table 35. This occurs because a greater proportion of the total costs in capital intensive systems are composed of capital and overhead costs when compared with systems that are less capital intensive. The capital and overhead costs are paid each year regardless of whether storage occurs or not. Variable costs are only incurred in the year of storage. Systems with a high proportion of variable costs relative to total costs will have a lower cost of storage when averaged over ten years because variable costs are only incurred in seven of the ten years of storage.

Discounted cash flow analysis

The average costs and benefits of grain storage can be used to assess the storage investment decision. It has been demonstrated that each of the different storage options has different net benefits to the farm business. A discounted cash flow analysis has been used to determine the viability of different options for grain storage. The discounted cash flow measures the net benefits of investments with large initial capital outlays followed by a stream of costs and benefits over a number of years. The net present value (NPV), which is the sum of the future cashflows, discounted at a nominated discount rate over the life of the investment assesses the viability and comparative merit of the investment.

If 100% of the funds for the storage investment were borrowed at a rate of 8% the NPV is the amount that is left after all of the borrowings, as well as the annual interest, is paid back. A negative NPV shows that the investment is not viable at the prescribed discount rate over the period of the investment analysis.

The comparative net present values of the grain storage systems when storing 500 tonnes of grain are presented in Table 36. The storage amount of 500 tonnes was chosen because this is the average tonnage produced in the south eastern Australian states.

The NPV has been taken over a period of 30 years with a salvage value of 15% of the purchase price of silos at the end of the period. Bagging machinery is assumed to have a life of only 10 years and new bagging machinery has been purchased every 10 years in this analysis. Variable and opportunity costs have been averaged over the 21 in 30 years of storage (70%) as have the freight rate advantage and the price advantage. Outloading is assumed to take place in July. A discount rate of 8% has been used. The NPV in the analysis has been taken before tax.

The costs and benefits of each system in this analysis differ to the costs and benefits presented previously because the costs and benefits have been averaged over the storage period. Storage is assumed to take place in 70% of years but costs and benefits are averaged over the 30 year analysis period. The average cost of storage in this analysis does not include depreciation or the interest on capital.

Does grain storage pay?

Figure 25 shows that grain storage in bags is the most cost effective of the grain storage options presented in this analysis.

Provided the net present value is positive then the investment is profitable. The storage option showing the highest net present value represents the storage option with the greatest returns to the grain grower. Grain storage bags provide the most profitable storage option with a net present value of $80,000 where grain prices rise by $30 in each year of storage. Large silos (250 t) are the next most profitable followed by warehousing and small capacity silos.

As silo size increases the capital costs decrease per tonne so larger capacity silos provide a greater net present value than smaller capacity silos provided they are filled to capacity. In this analysis the net present value of a 250 tonne silo system is $64,000 while the net present value of a 60 tonne silo system is $32,500.

The net cost of warehousing is $7-10 per tonne greater than silos or bags. This results in a reduced net present value of $45,000 when compared with large silos and grain bags. Warehouse storage is assumed not to provide the out-of-harvest freight rate advantages that have been applied to the other storage systems. This has contributed to the high cost of warehouse storage relative to other storage options except the 60 tonne silo system.

Table 35: Costs and benefits of grain storage systems ($/t) seven months after harvest assuming grain is stored every year. Excludes any price benefit.

	Grain storage bags	**Silo - 60 tonne**	**Silo - 250 tonne**	**Warehouse**
Costs				
Opportunity cost	$7.93	$7.93	$7.93	$7.93
Overhead, capital and depreciation cost	$6.86	$14.72	$10.41	$0.00
Variable cost	$8.27	$4.11	$3.38	$23.30
Total costs of storage	**$23.07**	**$26.76**	**$21.72**	**$31.23**
Benefits				
Freight	$2.20	$2.20	$2.20	$0.00
Comingling	$0.00	$0.00	$0.00	$0.00
Total benefits of storage	**$2.20**	**$2.20**	**$2.20**	**$0.00**
Net cost of storage	**$20.87**	**$24.56**	**$19.52**	**$31.23**

Table 36: Net present value of an investment in 500 tonnes of grain storage where a grain price increase of $30 per tonne occurs between harvest and July delivery

	Bags	Silo 60t*	Silo 250t+	Warehouse
Total capital investment	$17,000	$99,000	$70,000	$0
Average cost of storage (excl capital and depr cost)	$11	$7	$6	$22
Net present value (NPV) $30 adv	$80,059	$32,564	$64,015	$45,800

* 9 x 60 tonne silos at $11,000 per silo

+ 2 x 250 tonne silos at $35,000 per silo

Table 37: Assumptions made regarding storage systems

Total tonnage stored	500 tonnes
Number of storage years	7 in 10
Grain price	$170 per tonne on farm
Farm to receival site storage cost	$18 per tonne (in-harvest)
Out of harvest freight discount	40%
In-loading bag machine cost	$17,000
Contract out loading cost	$400 per bag
Bag cost	$880 per bag
Sealed 60 tonne silo cost	$11,000
Sealed 250 tonne silo cost	$35,000
Expected silo and shed life	30 years
Warehouse storage and handling fee	$7.00 per tonne
Warehouse monthly fee (Feb – Jul)	$6.15 per tonne
Warehouse outloading fee	$4.00 per tonne

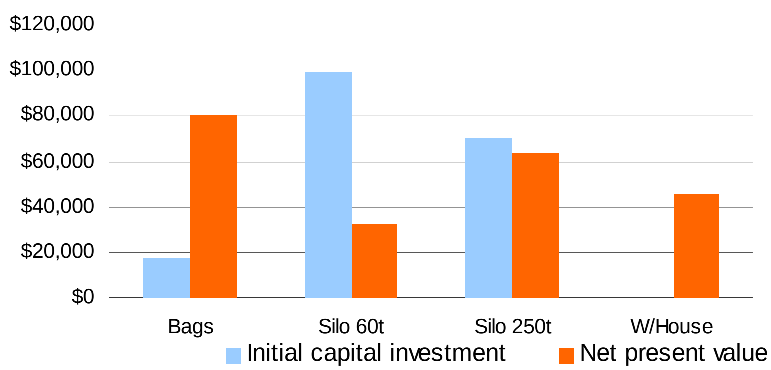

Figure 25. Net present value and initial capital investment of different storage systems

Summary

On farm grain storage can provide a useful price risk management tool for grain growers provided the price benefit exceeds the cost of storage. The profitability of an investment into grain storage depends on the system implemented, the quantities stored and the price advantage achieved.

Grain storage bags are a highly cost effective storage method due partly to the low capital costs involved. Based on the assumptions in this analysis grain storage bags are the most cost effective grain storage method followed by storage in large capacity silos. Warehousing is more cost effective than storage in small silos.

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Strategies for the control of stripe rust in wheat using seed treatments and fertilizer amendments (results from 2005)

Author: John Seidel

Contact No: 0429 039 322

Organisation: Peracto Pty Ltd

Location: Walla Walla
Soil:
Type: Silty Loam
pH (H_2O): 5.5
Sowing Information:
Sowing date: 15/6/05
Fertiliser: 100 kg/ha MAP
Plot Size: 1 m x 11 m
Replicates: 4

Key Messages:

- Farmers should avoid growing varieties that are susceptible to stripe rust.
- If a susceptible variety has to be grown then farmers have a range of options for the control of stripe rust.
- Well-timed foliar fungicide sprays will provide cost-effective control of stripe rust.
- Use of seed treatments and fertilizer amendments will provide early to mid season control of stripe rust but will have to be supplemented by foliar fungicide sprays for susceptible varieties.

Aim:
To compare a range of fungicide strategies for the control of stripe rust in the susceptible wheat variety H45.

Method:
The wheat variety H45 was sown at Walla Walla in a small plot trial in a randomized complete block design with 4 replications. The trial was sown on 15th June 2005 with 100 kg/ha of MAP.

Treatments were applied as seed treatments, fertilizer amendments or as foliar sprays or a combination of fertilizer amendments followed by two foliar sprays.

Results:
Stripe rust was first detected in the trial on 29th August 2005 at the 2nd node stage, 76 days after sowing.

Table 38: Mean percentage of plants infected with stripe rust at 78 and 90 days after sowing (DAS)

No.	Treatment	Rate g ai/ha or /100 kg seed	% Plants Infected with Stripe Rust	
			78DAS 2nd Node	90DAS 3rd Node
1	Untreated seed	Nil	0.25	5.8 B
2	Triadimenol C 150 FS seed treatment	22.5 g ai/100 kg seed	0.25	4.0 B
3	Fluquinconazole 167 FS seed treatment	75 g ai/100 kg seed	0	0.3 A
4	Flutriafol on fertiliser 250 SC	100 g ai/ha	0	0.3 A
5	Triadimefon 500 WP on fertiliser	100 g ai/ha	0	6.0 B
6	Untreated seed & propiconazole 250 EC foliar sprays at DC33 & 61*	Nil 62.5 g ai/ha	0	6.3 B
7	Flutriafol on fertiliser & propiconazole 250 EC foliar sprays at DC33 & 61*	100 g ai/ha 62.5 g ai/ha	0	0.3 A
p-value			-	0.009
LSD(p<0.05)			-	Data transformed

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

*Note that the foliar sprays had not been applied at the time of the 90DAS assessment.

Table 39: Mean percentage leaf area infected with stripe rust at beginning of flowering DC61 (11/10/05)

No.	Treatment	Rate g ai/ha or /100 kg seed	Leaf Assessed			Mean % Leaf Area Infected
			Flag	Flag-1	Flag-2	
1	Untreated seed	Nil	12.4	25.3	34.9	24.2 c
2	Triadimenol C 150 FS seed treatment	22.5 g ai/100 kg seed	12.7	25.3	26.0	21.4 c
3	Fluquinconazole 167 FS seed treatment	75 g ai/100 kg seed	7.0	11.7	8.6	9.1 abc
4	Flutriafol on fertiliser 250 SC	100 g ai/ha	3.0	5.1	5.5	4.5 ab
5	Triadimefon 500 WP on fertiliser	100 g ai/ha	8.7	14.1	15.5	12.8 bc
6	Untreated seed & propiconazole 250 EC foliar sprays at DC33 & 61	Nil 62.5 g ai/ha	1.2	0	0	0.4 a
7	Flutriafol on fertiliser & propiconazole 250 EC foliar sprays at DC33 & 61	100 g ai/ha 62.5 g ai/ha	0.8	0	0.1	0.3 a
p value						0.0000
LSD (5% level)						Data transformed

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Table 40: Mean percentage leaf area infected with stripe rust at kernels 50% extended DC 70.5 (26/10/05)

No.	Treatment	Rate g ai/ha or /100 kg seed	Leaf Assessed			Mean % Leaf Area Infected
			Flag	Flag-1	Flag-2	
1	Untreated seed	Nil	75.6	86.3	93.6	85.1 e
2	Triadimenol C 150 FS seed treatment	22.5 g ai/100 kg seed	72.0	83.2	81.4	78.9 de
3	Fluquinconazole 167 FS seed treatment	75 g ai/100 kg seed	58.7	67.8	51.2	59.2 bc
4	Flutriafol on fertiliser 250 SC	100 g ai/ha	53.7	57.3	45.0	52.0 c
5	Triadimefon 500 WP on fertiliser	100 g ai/ha	56.6	78.6	75.4	70.2 cd
6	Untreated seed & propiconazole 250 EC foliar sprays at DC33 & 61	Nil 62.5 g ai/ha	30.0	13.8	4.4	16.1 a
7	Flutriafol on fertiliser & propiconazole 250 EC foliar sprays at DC33 & 61	100 g ai/ha 62.5 g ai/ha	17.7	6.5	1.6	8.6 a
p value						0.0000
LSD (5% level)						14.148

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Table 41: Mean grain yield

No.	Treatment	Rate g ai/ha or /100 kg seed	Grain Yield t/ha	Index UTC=100
1	Untreated seed	Nil	1.80 c	100
2	Triadimenol C 150 FS seed treatment	22.5 g ai/100 kg seed	1.86 c	103
3	Fluquinconazole 167 FS seed treatment	75 g ai/100 kg seed	2.81 b	156
4	Flutriafol on fertiliser 250 SC	100 g ai/ha	3.17 b	176
5	Triadimefon 500 WP on fertiliser	100 g ai/ha	2.17 c	121
6	Untreated seed & propiconazole 250 EC foliar sprays at DC33 & 61	Nil 62.5 g ai/ha	7.08 a	393
7	Flutriafol on fertiliser & propiconazole 250 EC foliar sprays at DC33 & 61	100 g ai/ha 62.5 g ai/ha	7.43 a	413
p-value			0.000	-
LSD(p<0.05)			0.548	-

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Table 42: Grain quality

No.	Treatment	Rate g ai/ha or /100 kg seed	Grain Weight kg/hL		% Screenings		% Protein	
1	Untreated seed	Nil	66.3	c	28.8	e	14.1	a
2	Triadimenol C 150 FS seed treatment	22.5 g ai/100 kg seed	66.6	c	26.5	de	14.1	a
3	Fluquinconazole 167 FS seed treatment	75 g ai/100 kg seed	68.3	bc	20.9	bc	14.2	a
4	Flutriafol on fertiliser 250 SC	100 g ai/ha	70.3	b	17.7	b	14.0	a
5	Triadimefon 500 WP on fertiliser	100 g ai/ha	67.6	c	23.9	cd	14.0	a
6	Untreated seed & propiconazole 250 EC foliar spray at DC33 & 61	Nil 62.5 g ai/ha	79.8	a	7.4	a	12.8	b
7	Flutriafol on fertiliser & propiconazole 250 EC foliar spray at DC33 & 61	100 g ai/ha 62.5 g ai/ha	80.8	a	6.1	a	12.7	b
	p-value		0.000		0.000		0.000	
	LSD($p<0.05$)		2.079		3.995		0.3757	

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Observation and comments:

When conditions for stripe rust are severe and the variety is susceptible to the disease then yield loss can be substantial. The use of a short term systemic seed treatment will provide limited benefit. The long term seed treatment such as fluquinconazole or a fertiliser amendment treatment such as flutriafol will delay the development of the disease until booting. These at-sowing strategies allow a more timely foliar application to be applied, offer protection if the paddock cannot be accessed due to wet soil conditions or spray contractor availability and offer other benefits such as take-all control. For susceptible varieties, a second foliar application will be needed to maximize yield.

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