Research for the
Riverine Plains
2004

Farmers promoting excellence in farming systems by providing quality information, leading research and sharing ideas for the economic, environmental and social benefit of the Riverine Plains.

Compiled by Lisa Cary Castleman
Edited by Lisa Cary Castleman & Tim Clune

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Chairman	David Cook	Shepparton	(03) 5829 2263
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Treasurer	Claire Nicholson	Wangaratta	(03) 5721 8400
Committee	Stuart Feldtmann	Goorambat	(03) 5763 3261
	Paul I'Anson	Burrumbuttock	(02) 6029 3210
	Adam Inchbold	Yarrawonga	(03) 5743 1749
	Frank O'Connor	Dookie	0418 318 761
	Graham Parker	Henty	(02) 6929 3445
	Jan Davis	Corowa	(02) 6032 4196
Administration	Fiona Hart	Wilby	(03) 5748 5022

Executive Support:

Victorian DPI	Tim Clune	Rutherglen	(02) 6030 4500
	Dale Grey	Cobram	(03) 5871 0600
NSW Agriculture	Lisa Cary Castleman	Lockhart	(02) 6920 5177
	John Francis	Albury	(02) 6041 6500

Riverine Plains Inc

PO Box 386

YARRAWONGA VIC 3730

Email: riverineplains@bigpond.com

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Acknowledgements

Compiling the 2004 edition has been a team effort this year.

The committee members all give freely of their time to attend meetings, initiate and organise events, and suggest priorities for future research projects, demonstrations and trials. They use their own experiences throughout the growing season and ideas from other farmers as a basis for suggestions.

The nature of agronomic improvement is as varied and diverse as the enterprises, soil types we manage and climate that comes our way. The agronomists and scientists that have put time into their research and extension of results to you would all appreciate your comments if you ever want to make the time. Please make use of their contact numbers which are provided.

To the private rural consultants John Sykes, Tim Paramore and Peter Baines that make such an important contribution, a big thankyou.

To all of the authors of papers and stories, especially the DPI staff and NSW Agriculture staff, thankyou.

To all of the members who pay their subscriptions and attend organised events the committee thanks you for your essential support. If you have new ideas or untapped resources then consider a committee position. We are always looking for new blood and help on the research, extension and sponsorship subcommittees.

Finally, the support given to Riverine Plains Inc by its financial sponsors is gratefully acknowledged. The sponsorship and membership combined allow it all to happen.

Lisa Cary Castleman & Tim Clune
Editors.

Preface

Trials versus demonstrations - what the results mean

Research in the Riverine Plains takes different shapes and forms. All of these forms have 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.

Understanding the difference between trials and demonstrations is important in the use of results for benefit on farms. A replicated trial means that each treatment is replicated a number of times and an average is used to present the results. The replication ensures that outside influences are reduced therefore producing the most accurate results possible. 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. This then allows an average of each variety to be taken whilst accounting for variations in soil type.

To then evaluate whether the treatments are different, a test called the Least Significant Difference (lsd) is often used. If no significant difference was found between treatments then the results will be represented with NS (not significantly different). If the statistical test finds a significant difference it is written as, for example, P=0.05. This means there is less than a 5% probability that the differences between treatments occurred by chance.

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

The above example shows a least significance difference of 0.5 t/ha. In evaluating these results only Variety 3 shows a difference greater than 0.5 t/ha from the other varieties. Therefore this 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 are accurate for the paddock chosen under the seasonal conditions incurred. However, care must be taken before applying the technology 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.

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. However, because they are not statistically replicated, they must be interpreted with care.

Area Covered by Riverine Plains Inc

Insert membership map from last year.

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INTRODUCTION

A Word from the Chairman of the Riverine Plains Farming Systems Group

David Cook, "Cowarie", Pine Lodge South, the Victorian Side of the Murray River

Despite whatever Mother Nature challenged us with in 2003, I dare say it was nothing compared to 2002. From the opening rains last autumn, the turnaround from a production perspective was obvious. It looked like the boom year following a drought was going to plan. However, in a year that promised so much, the latter part of the season seemed to produce a continual number of problems. Stripe rust, bacterial blight in peas, irregular spring rain, frost events and substantial rain (Harvest rain) at the wrong times caused, alone or in combination, a frustrating run up to harvest.

If monitoring was the key to 2003, adaptability will be the key in 2004. There is a big need for changes to many cropping programmes following the change to wheat stripe rust ratings and the dilemma of the breakdown of the Sylvestris resistance in canola. Many want to change but are finding the alternatives less than ideal. Changes to some rotations are likely whilst planning for possible fungicide applications is only adding to the escalating cost spiral. The past 12 months has reinforced the importance of disease resistance selection in breeding new varieties but as usual, everything takes time.

So what should we expect in 2004? Well it's anyone's guess as to which way the $AUD and world wheat prices are heading – there are cases for big movements both ways. With the recent continuing consolidation of grain marketing and accumulation companies in Australia and the introduction of the Australian Financial Services Act, a revolution in the provision of financial services, the grain marketing arena is changing at a rapid rate.

As a result, independent market information of a specific nature will become harder to source in this environment, with growers needing to improve their marketing skills and knowledge. The common problem many face is the skills and time required to keep abreast of all markets. Perhaps a marketing consultant may become as integral a part of a farms management team as an agronomist/consultant in the future.

Riverine Plains has strived to present valuable information over the past 4 years. With a recent restructure of the committee and the employment of Fiona Hart as our own General Administrator, Riverine Plains will endeavour to increase and improve the flow of information to members. One of the areas where you will see a definite change is the holding of more events at a local level, as with our recent pre-season meetings, especially where issues arise during the year that will be relevant to your area.

Thanks to the team who made Research for Riverine Plains 2004 happen this year. Lisa Cary Castleman, Tim Clune and Adam Inchbold have done a great job in collating and editing the book.

With the workload everybody was under last year, it is time I publicly gave thanks to the wonderful Riverine Plains committee for their time, efforts and energy they put into 2003. A little extra thanks must be given to the executive (Hamish Sinclair, Malcolm Ferguson and Jan Davis) for their ongoing efforts and to Lisa Cary Castleman and John Francis (NSW Agriculture), Dale Grey and Time Clune (DPI Victoria) for the workload they take on over and above their job commitment.

Farmers Malcolm Ferguson (Corowa) and Angus Campbell (Yarrawonga) leave the Committee this year and I thank them for their time given to Riverine Plains. Malcolm, one of the inaugural steering committee members in 1999, has been a great asset as Treasurer and for his challenging and inquiring mind. Angus has been a committed contributor who focused on new information needing to be both timely and relevant for the majority of members.

Finally, thanks to all those who keep Riverine Plains operating. The support from GRDC and the Joint Centre for Crop Innovation (JCCI) in our research endeavours is much appreciated. With ever increasing demands on their support from many areas, the support and commitment of our sponsors has been great. Please support them where you can. To all our members, thank you for your continued support.

A Seasonal Overview for the Riverine Plains North of the Murray River Based on the Annual Report for the Albury District

John Francis, NSW Agriculture District Agronomist, Albury (NSW)

Introduction:

This report is collated from monthly reports written through the year. The information is limited to my experience in the Albury agronomy district. While this report has an Albury district bias it is likely that the same issues that arose in the Albury district were faced by farmers and agronomists across the wider area covered by the Riverine Plains Farming Systems Group. Weather information for this report was sourced from the Bureau of Meteorology website at www.bom.gov.au.

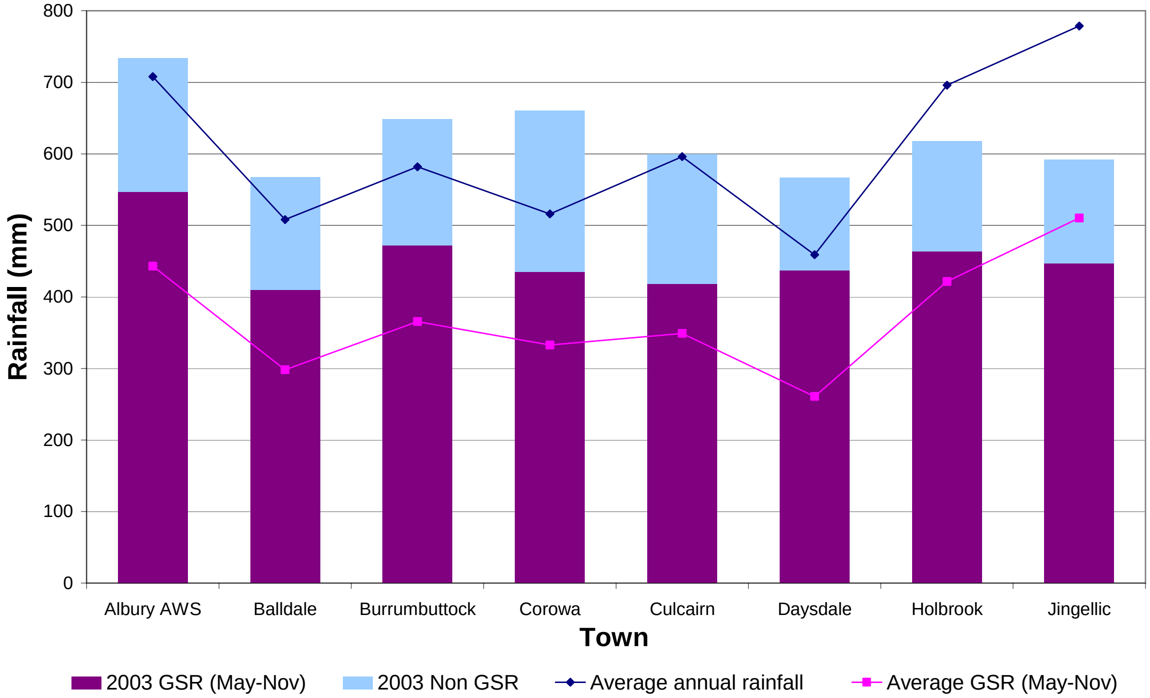
Weather Summary:

Rainfall during 2004 was around the long term average for most towns in the Albury district. A significant proportion of the total annual rainfall fell when it was most needed, in the winter crop growing season. Growing season rainfall (GSR) in 2003, throughout most of the intensive cropping zone, was approximately 20 to 70 percent greater than the long term average annual growing season rainfall. Refer to figure 1.

Average maximum and minimum monthly temperatures were approximately 1°C warmer than the long-term average from March to July which allowed for quick early crop development. August and September were slightly cooler than average while maximum daily temperatures in October were 2.7 degrees Celsius cooler than average. November was hot and dry with two days above 35°C and rain falling two weeks later than it was needed, in the fourth week.

May had 5 less frosts than average, June had 10 less frosts than average and July to October had around the same number of frosts as the long term average. Late frosts were experienced on September the 28th and 30th and October the 11th with the intensity and duration of the frosts varying depending on altitude and location.

Figure 1. Albury district rainfall 2003 against average



January to the start of April

January was hot and dry with the only significant rain on the first day of the month. Late February rain fell across most of the district but the amount received varied considerably. Some farmers in the east of the district sowed oats and long season winter wheats in an attempt to generate early autumn feed. The rain did little to replenish dams and water carting continued for many farmers in the district. Sub clover germinated in many parts of the district but as temperatures rose in mid March there was little hope of survival. March provided little follow up rain and it wasn't until mid April that further rain was received.

Pre-season industry issues included the discovery of the wheat streak mosaic virus in Australia. Federal agencies, state agencies and industry representatives acted in the best interests of the industry to prevent the spread of the disease but surveys (sampling) suggested that the disease was already widespread and containment was unlikely. Australian seasonal conditions are not as favourable as in the USA and so the economic impact of the disease is likely to be quite small.

Other pre season issues related mainly to the drought including herbicide carryover, nutrient carryover and likely disease risks. Some canola yield reductions and total crop failures occurred due to residual herbicide carryover from the 2002 season. The widespread extension campaign warning farmers of the risks of herbicide carryover did however help to minimise yield loss.

April

Western parts of the district, around Corowa, received up to 50mm for April but other parts of the district only received half as much rain. Sowing started around the 15th April after the first rainfall event of the month on the 12th and 14th. Sowings of winter wheat, long season spring wheat, oats, lupins and canola have all started. By the 24th April sowing moisture was becoming very marginal but many farmers decided to keep going (mainly for logistical reasons). Follow up rain from the 27th to the 30th April helped to join the moisture again in some cases but again it was patchy.

The warmer than average temperatures, the frost free conditions until the end of April and the warm ground temperature were extremely favourable conditions for both crop and pasture growth but the very low subsoil moisture content and the marginal sowing moisture were still cause for concern at the end of April.

Sub clover and annual grasses germinated on the rain and follow up rainfall towards the end of the month ensured their survival. Again, lucerne proved its place in the farming system by taking the pressure off hand feeding.

May

Good rainfall was received in the west of the district with the highest figures recorded around Corowa and Mulwala with up to 60mm for the month. Rainfall again varied considerably across other parts of the district. East of the Hume highway was still desperately in need of good rainfall with only sporadic falls being recorded over April and May.

Warm daytime conditions continued through May with the average maximum and minimum monthly temperature approximately 1.5°C above the long term average. The mid May rainfall gave many farmers to the north and east of Albury the first opportunity to sow.

The rain freshened early sown crops to the west and north west of Albury. The rain also germinated dry sown crops and provided enough moisture to finish the cropping program for farmers in that part of the district.

Early sown crops grew quickly in the warmer than average conditions and those that germinated before the end of April were well established. Dry sown cereals and canola established very evenly. Some canola paddocks in the district suffered damage from Bryobia mite, Ballaustium mite and Sitona weevil.

June

This was the first month of the year that rainfall was fairly even across the district with most of the district receiving close to average rainfall. The rain was spread over the month allowing at least enough groundcover in most parts of the district to prevent soil erosion. Daytime temperatures dropped considerably through the month and growth of crops and pastures was noticeably retarded as a result.

The majority of crop in the Albury district was sown by the end of June. Early sown cereals were at the mid tillering stage and early sown canola at full rosette. Early sown winter grazing cereals were stocked during June taking some of the pressure off hand feeding. Eastern parts of the district were still the driest with many sowing outside of the ideal sowing windows as the opportunity to sow on time did not present itself.

Some herbicide residues were showing up in crops (canola on SU treated 2002 and cereals on triazine treated 2002) but only a few cases with severe damage or total crop failure. Rhizoctonia was widespread as was yellow (leaf) spot, particularly where susceptible varieties were sown in paddocks with stubble residue.

The pasture growth rate website (http://www.pgr.csiro.au) shows that pastures were growing only at a rate of 0-10kg/ha/day on the week starting 18th June. Pasture growth rates for the week starting 11th June were 10-20kg/ha/day in most of the Corowa shire but still only 0-10kg/ha/day through the remainder of the district. The parts of the district that received good rain in late April and early May can clearly be seen on the map.

Pastures had particularly high weed burdens. Spray timing was difficult as the pastures were not yet advanced enough to spray but the weeds were starting to become large. Spraying pastures always seems to be a compromise between the correct growth stage of the weeds (small) and the correct growth stage of the pasture (large).

July

Good rain was recorded in all towns across the district for the month of July. Most of the rain fell on the 24th and 25th of July with 50mm recorded in one day at Albury. The rain provided some runoff for dams in the district but there were still a large proportion of dams in the district that were far from full. Daytime temperatures were unseasonably warm with the average maximum monthly temperature 1.0°C above the long term average for Albury.

Early sown spring type cereals were at the stem elongation growth stage while early sown winter cereals were nearing the first node detectable stage. Early sown canola was past stem elongation with the first flowers just starting. Early sown winter grazing cereals continued to provide good quality feed.

Phytotoxic effects of herbicides appeared to be much worse than normal with some crops exhibiting severe leaf discolouration. Yellow (leaf) spot incidence was high with symptoms worst where susceptible varieties have been sown back into wheat stubbles. There was much more talk of fungicide use to minimise yield loss from leaf diseases this year than in the last few years. Farmers were encouraged to confirm field diagnoses of leaf diseases with a laboratory test before outlaying money for fungicides. Late sown cereals were showing symptoms of colour banding. This is a mostly benign natural phenomenon occurring in some cereal crops on the first and second leaves. It was due mostly to cold nights and sunny mornings in the early developmental phase of these crops.

Lupins, field peas and faba beans looked healthy and were on target to meet yield potential.

A large proportion of the perennial and annual pastures in the district were sprayed for the usual weeds (Paterson's curse, Capeweed, Shepherds Purse, and Erodium spp). Some clover damage was reported with tankmixes of Terbutryn (Igran) and MCPA – possibly due to the frosts recorded from the 18th to the 20th July followed by the 18°C day on the 23rd July.

The pasture growth rate website shows that pastures were growing at a rate of 10-20kg/ha/day on the week starting 23rd July in the Corowa shire and the westernmost part of the Hume shire. Pasture growth rates for the eastern part of the Hume shire and the Holbrook shire at the same date remained at 0-10 kg/ha/day. Pasture growth rates for the week starting 30th July 2003 increased by 10 kg/ha/day on the previous week.

August

Excellent rainfall was received across the whole of the district for the month of August. It was a perfect follow up after the good July rainfall. The saturating rains occurred early in the month which resulted in good runoff with many dams in the district filling and good runoff into the Hume dam. The volume of water in Hume dam increased from less than 10% in May to 46% at the end of August. Much of the district now had a full profile of moisture to carry crops into spring. This was the 5th wettest August on record for Albury.

Early sown crops were well developed with full canopy closure in most cases. Early sown cereals were at the booting (Z40-49) to head emergence (Z50-59) growth stage. Some late sown cereals still had not reached the jointing (Z31-32) growth stage but most were at stem elongation (Z31-39).

Deep soil nitrogen test results had been poor with the majority coming back with nitrate levels lower than expected. The low rate of mineralisation was suspected to be part of the reason for the low readings. Most cereals were topdressed after jointing in an attempt to reduce the number of wasted tillers and maintain grain number and weight.

Canola crops in the district were flowering. Some blackleg started to appear in bolting canola. One canola sample was diagnosed with white rust. Gordon Murray (NSW Agriculture plant pathologist) noted that the disease had been unusually common during 2003.

Winter cleaning of pastures continued. Terbutryn (Igran) was in short supply so farmers resorted to other tankmixes which had reduced efficacy on the range of weeds targeted.

The pasture growth rate website shows that pastures were growing at a rate of 20-30 kg/ha/day on the week starting 20th August in the Corowa shire and the westernmost part of the Hume shire. Pasture growth rates for the eastern part of the Hume shire and the Holbrook shire at the same date remained at 10-20 kg/ha/day.

September

Rainfall was slightly below average for the month of September but the rainfall incidence was above average. Evaporation rates were kept low during September and the maximum temperatures for Albury were lower than the long term average. The district was looking amongst the best in the state. Potential grain and dry matter yields were above average at this stage.

Stripe rust was found in the Hillston district on the 12th September and appeared on the western edge of the Albury district about one week later. Agribusiness agronomists, consultants and NSW Agriculture staff worked quickly and efficiently to ensure that H45 (the most stripe rust susceptible of the varieties) was sprayed with fungicide. By the end of the month an estimated 90% of the district's H45 crops had been sprayed. Cases of high pressure in other varieties, particularly Chara, were reported.

There was one temperature spike on the 22nd September but the majority of crops had not yet flowered at that time. Cereals yields of greater than 5t/ha were achievable at this stage.

Canola crops in the district were flowering with most past mid flower. Inquiries about spraying for sclerotinia started but the cost of the fungicide (approximately $70/ha) and the recommended water volume (>100L/ha groundrig or >45L/ha air) without any guarantee of an economic yield response prevented uptake by most canola-growers.

Pulses still looked promising but the damage from the frost of the 28th was yet to be assessed.

The pasture growth rate website shows that pastures were growing at a rate of greater than 60 kg/ha/day on the week starting 24th September in the Corowa shire.

October

Rainfall was slightly above average for the month of October. Temperatures were unusually low with the average daily maximum and average daily minimum for the month both well below the long term average.

The mild October conditions had been ideal for crops that flowered at the start of the month. Early sown crops in the westernmost parts of the district (Corowa, Daysdale, and Rennie) had huge potential at this stage. Crops in the Brocklesby, Burrumbuttock, and Howlong area were slightly later but still had very high yield potential.

The frost of the 28th September caused only isolated damage to cereals as the majority of crops had not yet reached the critical growth stage of flowering. There were isolated reports of up to 75% yield loss of crops at the booting stage. Temperature data loggers in a paddock at Burrumbuttock at head height showed that temperatures on October 11, 27 and 30 reached -3.5, -1.7 and -1.2 degrees Celsius respectively. This event caused widespread damage though it appears that the majority of losses were minimal.

Some hail damage was reported when a storm hit the west of the district on the 15th October. The Stripe rust epidemic continued through October as a result of the mild conditions. Most of the H45 crops were sprayed with fungicide in a very timely manner due to an excellent collaborative extension campaign between agribusiness agronomists, consultants and NSW Agriculture. Other varieties appear to have been more susceptible to stripe rust than their disease ratings suggested they should be. A number of factors; the high spore load, the early appearance of stripe rust (3 weeks earlier than normal), the lower than average temperatures through October and the appearance of the new Western Australian race all contributed to the increase in susceptibility of some varieties.

Canola crops in the district looked to have excellent yield potential. There was very little insect pressure (possibly due to the mild temperatures through September and October). Some crops had suffered frost damage but it appeared to be only minimal.

Pulse crops looked fantastic with the mild conditions and good moisture being ideal for finishing. Lupins hit early by brown leaf spot early had recovered well and yield potential in most crops was high. Bacterial blight and frost had impacted severely on field peas though the real extent of the damage wouldn’t be known until after harvest.

Silage and hay cutting was in full swing with many farmers looking to replenish fodder supplies that were depleted over the last 12 months. Yields and quality were high. The pasture growth rate website shows that pastures were growing at a rate of greater than 60 kg/ha/day on the week starting 30th October.

November

The first three weeks of November were very hot and dry which resulted in significant loss of crop yield potential and rapid haying off of pastures. Good general rainfall was received in the third week of November but the hot dry conditions preceding the rainfall had already reduced yield potential. The rain delayed the canola harvest which was just starting in the westernmost parts of the district.

The rain fell two or three weeks too late in western parts of the district to be of significant benefit but cereals in the mid district and eastern parts of the district had enough green leaf and stem to benefit from the rain. The hot weather from the 5th to the 22nd of November reduced yield potential of cereals significantly. Maarten Stapper, CSIRO Principal Research Scientist, suggests that each 1°C above the average temperature of 14°C at flowering and grain fill reduces yield by 5%. November temperatures averaged 18.1°C equating to a 15% yield loss. This translates to a reduction from potential yield of 5T/ha to 4.25T/ha. Crown rot was again being seen in the field. Mould growth was appearing on wheat that had senesced.

Canola windrowing started in the third week of November. There were no reports of insect damage in canola which was a welcome relief after the problems of last year (with diamondback moth). Very little canola was harvested prior to the end of the month but initial reports were of yields greater than 2T/ha and oil contents of greater than 42%. Confidence in canola had been renewed again.

Pulse crops still looked good early in the month but the hot weather and dry conditions had a severe impact on grain size. Mould growth was appearing on lupins as was phytophthora root rot.

Significant quantities of hay were cut or baled but not yet stacked when rain fell in the 3rd week of November. The pasture growth rate website shows that pastures were still growing at a rate of greater than 60 kg/ha/day on the week starting 19th November.

December

Significant rainfall at the start of the month and during the middle of the month not only stopped harvest for two to three weeks but also resulted in downgraded grain quality in some parts of the district.

The rain during the first week of December delayed harvest but surprisingly, did not have a significant effect on grain quality. The rain on the third week of December further delayed harvest and resulted in quality downgrading. Reports of shot and sprung grain in western parts of the district resulted in feed quality grain and an associated reduction in grower returns. Many eastern parts of the district did not receive the amount of rain that fell in the west and grain quality had not been reduced to the same extent.

Canola was the first crop harvested with dryland yields over 3 tonnes per hectare (T/ha) and oil contents over 46% achieved. Many farmers averaged over 2.2T/ha with oil contents greater than 42%. Low levels of disease, rainfall incidence throughout the season and the mild spring finish all contributed to the good canola yields.

Cereal yields in the Corowa shire were around 4 to 5T/ha while crops in the Hume shire were slightly lower due mainly to the later start and shorter season. Grain quality was all over the place with screenings and protein ranging widely.

Yield of pulses was extremely disappointing with the frost and bacterial blight apparently responsible for the poorer-than-expected yield of field pea crops and the quick finish diminishing lupin yields. 2004 planting of pulse crops is expected to decline considerably.

Summer weeds grew prolifically, after the rain. Many of the weeds that emerged on the early December rain produced viable seed by the end of the month. Control of summer weeds was a low priority issue for farmers because many were still harvesting well into January.

Lucerne responded instantly to the rain and looked very lush. Lucerne pastures sown under crops harvested in 2003 also looked good and were soon ready for a light grazing. Interestingly, the pasture growth rate website shows that pastures were growing at a rate of only 10 kg/ha/day, 50 kg/ha/day and >60kg/ha/day on the weeks starting 10^{th}, 17^{th} and 24^{th} December respectively. This was due most likely to a combination of lucerne growth and weed growth.

A Summary South of the Murray River for 2003

Dale Grey, DPI Agronomist, Cobram (Victoria)

The year 2003 will be remembered for its excellent yields, its huge crop canopies, the poor quality of grain due to rain damage, stripe rust and the many abnormalities in the weather.

The seasonal break started in mid April for some farmers in the Tungamah, Burramine, and Wilby areas after a dry January, February and March. A solid 50 mm storm kicked off the early sowing of canola and some Whistler wheat. For the rest of us the real break started a month later on the 15th May with a solid storm front through the majority of the region. This start to the season was followed up with a few small showers throughout June. The lack of good follow-up rain led to many later sown crops having less than adequate germination and plant densities. Significant rainfall eventually fell on the 30th June and this started the change in the season from being marginal for moisture, to being adequate for most of the growing season. The stormy nature of the seasonal break was constantly repeated throughout the season with few rains having a general widespread effect.

Daily minimum temperatures throughout winter were generally 1-2 degrees higher than average. This led to rapid growth of both crop and pasture dry matter. Many early sown crops were plainly too vegetative towards the end of winter. This was exacerbated by daily minimum and maximum temperatures in August, September and October 1-4°C below normal, leading to an English-like finish to the season. Coupled with these conditions was the arrival of a new stripe rust strain capable of attacking most of our previously resistant varieties. Weather conditions were perfect for its spread and the susceptible variety H45 benefited from fungicide spraying. Few other varieties benefited from spraying because once again the spring changed against us.

Pan evaporation for the last 10 days of October averaged 3.6 mm, with the average temperature only 17.2°C at Rutherglen. Flowering was delayed in many crops due to the cool spring and anthesis was from 20th October onwards. The period from 5th November to 15th November averaged 27.9°C and 6 mm evaporation. This culminated in a 36°C day on the 15th, 8 degrees warmer than anything our crops had experienced all year. It is highly likely that this coincided with a huge deficit in soil moisture at a critical time in grain fill. We had

had no substantial rain for at least 25 days. This was what is termed a heat shock event and goes some way to explaining the effects on crop types that we saw.

Canola performed excellently with yields from 2.5-3.0 t/ha and good oil contents. Barley generally performed above expectations, with dryland yields up to 7 t/ha but with retention problems. Wheat performed as expected with most crops yielding up to 5 t/ha but grain size was small. Triticale was disappointing with yields in the order of 4-4.5 t/ha and peas and lupins were shocking at 1-2 t/ha. The heat shock theory goes a long way to explaining these performance differences with the earlier maturing crops such as barley and canola doing well and the late maturing triticale, peas and lupins being most affected. Many lupin paddocks literally died in the paddock without filling much grain and turning black with the rain that then fell on them. Interestingly irrigated crops that were fertilised well and watered, still failed to achieve target yields greater than 6 t/ha. Whether this is from heat shock or excessive early vigour is unknown.

Because of the warm winter, crops were quite vulnerable to the effect of frost, of which there were a number throughout the season. There were 12 days from 15th August that were less than -0.5°C. Four of these days were preceded by rain, which is highly atypical, and this caused drop freezing in stems and heads and gave the characteristic dead heads that emerged from the boots. Severe frosts on September 28th and 30th, a -0.4°C on October 12th and +0.2°C on November 4th meant that all over the region crops sown either early or late were in a vulnerable stage of growth when flowering and grain yields were affected by frost. Some unfortunate growers experienced yield losses of up to 70%.

Table 1 shows the rainfall for a spread of localities across a range of rainfall zones. What is most noticeable is that irrespective of the area the season was above average. Generally drier areas such as Picola were well above average (decile 8) and wetter areas such as Rutherglen were only slightly above average. At the Z32 stage when serious N decisions were being made, the PYCal prediction was around decile 7-8, and while the season did not turn out on the wetter side of this, it gave a good indicator as to the target yield. Potential yields varied from 4.0 - 6.9 t/ha. In practice, many canola and wheat crops achieved their potential of 20 kg/mm growing season rainfall (GSR). Nitrogen (N) uptake efficiency was less this season than in the last two years and in the order of 42%, compared to an expected 50%. The large canopies and then the warm conditions at grain filling probably accounted for the poor translocation of N into the grain.

Table 1. PYCal predicted yields and final seasonal rainfall data

Location	Decile	Subsoil (mm)	GSR* May-Oct	Wheat t/ha	Canola t/ha
Euroa	7	71	381	6.9	3.4
Thoona	8	18	381	5.8	2.9
Rutherglen	6	18	378	5.7	2.9
Stewarton	7	17	374	5.6	2.8
Boorhaman	6	32	353	5.5	2.7
Yarrawonga	7	21	333	4.9	2.4
Cobram	7	21	319	4.6	2.3
Katamatite	7	15	318	4.5	2.2
Congupna	6	21	301	4.2	2.1
Picola	8	30	278	4.0	2.0

*GSR Growing Season Rainfall

In conclusion the season finished wet to very wet with many areas receiving up to 150 mm during the harvesting period. Grain was soon downgraded with the worst case scenario of shot and sprung becoming a reality for some. A frustrating harvest was had with large lines of trucks at receival points and handlers seemingly surprised with the tonnages received (don't say I didn't warn them!). Harvest eventually finished in late January with a record breaking wheat crop for Victoria and I would think for the North East region.

Lessons learnt North of the Murray River from the 2003 Season

Lisa Cary Castleman, NSW Agriculture District Agronomist, Lockhart (NSW)

There are some important simple messages that I walk away with after last season.

You ALWAYS need more than one string to your bow. This applies whether we are talking about wheat varieties, canola varieties, the number of crops you grow, rotating herbicide groups, whatever. Exposure to risk is too great in any one season if you operate any other way. It might be grain or wool prices, climate changes, pests or diseases, debt levels, the list goes on. Years of careful planning can all come undone quickly in a poor season or in unforeseen circumstances.

Balancing risk means making tough decisions when you need to, not avoiding decisions. In 2004 canola areas will bounce back to where they should be as long as the Autumn Break doesn't come too late. Pulse crops will be popular only where growers are able to credit them with consistent performance. There are localities where they appear to be particularly well suited due to the loamier soil type and later finish to the season. Know your figures on breakeven yields and profitability and let the figures speak for themselves. If you consistently lose money by growing pulse crops then don't do it for so called sustainability reasons. It's hardly sustainable in that instance is it? If you do make money out of them, then you would be in the minority but keep doing what you're doing.

If you wait long enough the plant pathologists' dire warnings of disease outbreaks will eventually come true. The plant pathologists and wheat breeders have warned growers in the south of NSW that growing H45 was risky (re disease risks) and not recommended ever since the release of H45. Growers were initially cautious and then based on solid yield performances in dry years planted an increasing proportion of their wheat crop to the variety. The outbreak occurred when there was a large enough area planted down to a susceptible variety, climatic conditions were ideal and growers had finally become complacent about the disease risks. It really was predictable in hindsight but the stripe rust outbreak was still a disappointing one for growers that had the expense of spraying foliar fungicides, and then for the lowering of adult plant resistance in other popular wheat varieties.

The maturity of a variety which indicates the time required between planting and harvest can be 'make or break' in a tough finish. While the timing of the Autumn Break remains all important, many growers recognise that an April Break is far less likely than a May break, and could pay more attention to selecting crop varieties on maturity. In recent seasons H45 had become a very popular wheat variety in southern NSW. Most growers would nominate that it was selected on performance, or yield. When you look at the run of seasons we have had in recent years, a great deal of its success can be put down to maturity. When H45 or a new variety like Drysdale is sown from the main sowing window onwards to late, it will finish earlier than others with its all important grain filling period avoiding the worst of rising temperatures and increasing moisture stress.

As science advances there is a greater choice of farm inputs available. Everybody wants your business. Do they all increase your profitability or do some of them start looking like major expenses with no guarantee of increased returns over and above the cost? Demand quality information from experienced and independent advisers. I do occasionally see results that I would regard as unconvincing. Ask yourself, in the barrage of mail that arrives regularly was the glossy spiel on a new product written by a well respected scientist, or conducted by an independent body or was it cleverly put together by a marketing department?

And that reminds me, this was one of the reasons Riverine Plains Inc. became an entity in the first place, to disseminate quality information, that you could interpret and have confidence in using.

If in doubt, check it out.

CROP RESEARCH ON THE RIVERINE PLAINS

2003 Devenish State Focus - Follow Up of 2002

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- 2003 wheat yield did not differ significantly between plots that previously grew various legumes in 2002.

Aim:

To assess residual nitrogen following different legume plots (2002) and to analyse the following wheat yield (2003).

Method:

Diamondbird wheat was sown by direct drill over the area of the previous year's legume plots. Nitrogen testing was carried out pre-sowing and in crop at the Z30 growth stage. Plot areas were harvested and yields were recorded with a yield monitor. The trial design is referred to as a nearest neighbour design.

Results:

Table 2. Diamondbird Wheat Yields in 2003 following 2002 legume plots

Variety	Nitrogen available pre-sowing (kg/ha)	Tillers/m^2	Yield (t/ha)	1000 grain weight (g)	Screenings (%)	Protein (%)
Nugget lentils	56	540	5.03	40.16	0.37	12.5
Parafield peas	83	488	4.94	40.98	0.38	12.0
Bumper chickpeas	132	520	4.58	41.20	0.72	11.8
Kaspa peas	94	456	4.52	40.33	0.29	12.5
Excell avg	76	536	4.89	40.34	0.55	12.2
LSD (5%)	**75.2**	**NS**	**NS**	**NS**	**NS**	**NS**
CV %	**17.9**	**5.6**	**2.9**	**2.2**	**36.7**	**4.0**

Note: NS denotes No Significant Difference ($p < 0.05$)

Observations and comments:

Wheat yields were good following legumes grown in the previous year. There was no significant difference in yield due to the different legumes. The peas yielded 2.0 t/ha in 2002. No significant differences between 1000 grain weights, or screening percentages were observed. Rainfall throughout the growing season was excellent, but the finish was relatively dry. Frost and hail occurred in spring. Soil tests suggested the Bumper chickpeas soil had increased nitrogen available pre-sowing.

Essential Details:

Location: Devenish	**Sowing information:** Rate: 90kg/ha Sowing date: 9/5/03 Fertiliser: 135kg/ha MAP 100kg urea @ 29/8/03	**Paddock history:** 2002 – various legume varieties	**Soil Type:** Grey duplex loam over clay **pH (H_20):** 5.5
GS Rainfall: mm Average GSR 310 2003 Apr – Oct 420	**Row spacing:** 25 cm	**Plant Density:** 140 plants/m^2	**Replicates:** Nearest neighbour design

Sponsors:

Thanks to Hamish Sinclair and his family, farmer and trial cooperator at Devenish in Victoria.

AWB/AWB seeds half page add

Dovuro full page ad

Boorhaman Cereal Variety Trial

Author: De-Anne Price & Dale Grey **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- The grain yield of 8 popular wheat varieties and Abacus triticale did not differ significantly in the Boorhaman regional cereal trial.

Aim:

To assess the yield potential of 8 different wheat varieties and Abacus triticale in the Boorhaman region.

Method:

Wheat varieties and Abacus triticale were sown in large plots (46m x 6.1m), at a rate of 80 kg/ha. DAP was applied at a rate of 110 kg/ha at sowing, in addition to 90 kg/ha of urea before head emergence. Harvest took place on 15th January 2004.

Results:

Table 3. Harvest grain sample results

Variety	Yield (t/ha)	1000grain weight (g)	Screenings (%)	Protein (%)	Plant counts/m^2	Head counts/m^2
Janz	3.10	32.36	3.45	9.6	171	274
Whistler	3.03	37.90	1.55	9.3	143	233
Wedgetail	3.03	35.93	2.62	9.1	125	233
Bowerbird	3.03	34.20	2.25	9.3	148	303
Abacus	2.83	35.38	3.45	9.0	86	233
Diamondbird avg	2.73	35.92	2.18	9.3	154	417
Chara	2.25	35.40	3.10	9.5	125	251
Swift	1.94	34.01	2.54	9.6	131	320
H45	1.76	34.43	3.72	9.0	91	213
LSD (5%)	**NS**	**NS**	**1.11**	**NS**	**54.11**	**n/a**
CV %	**21.3**	**4.2**	**14.1**	**2.9**	**12.9**	**n/a**

Note: NS denotes No Significant Difference ($p < 0.05$)

Observations and comments:

- While there are numerical differences in yield between varieties there were no statistically significant differences and the variability across the trial was substantial. The variation accounted for an unacceptably high coefficient of variation (CV %) of 21.3%, which means differences in grain yield should not be examined seriously as they are not repeatable. This sort of situation can arise in a trial where for instance there is frost up one end, and not down the other, or where soil types vary across the trial. Variation within trial treatments is always best avoided if possible but it is an important reminder that trying to interpret raw or paddock data that has not been analysed (using rigorous statistical methods) is fraught with danger, and there is ample opportunity by the reader to misinterpret what actually happened.

- Given the growing season rainfall, expected yield was in the order of 5.5t/ha. Yields therefore did not meet potential. Moisture was marginal at sowing and establishment was patchy. Grass weed competition was high in thin patches.
- Janz yielded the highest, but with the smallest seed size, and high screenings.
- H45 yielded poorly but plant counts and head counts were low. Little stripe rust was evident.
- Swift had a relatively high head count, but yield was still poor.
- Protein was low for all varieties. No rain fell after the late topdressing until 100 mm in December.
- The low plant counts for H45 and Abacus (both low tillering varieties) meant yield potential was unlikely to be maximised.

Essential Details:

Location: Boorhaman	**Sowing information:** Rate: 80kg/ha Sowing date: 23/5/03 Fertiliser: 110kg/ha DAP 90kg/ha urea	**Paddock history:** 2002 - Lupins 2001 - Pasture 2000 - Pasture	**Soil Type:** Red duplex
Rainfall: GSR average: 370mm 2003 GSR: 380mm	**Row spacing:** 17.5cm	**Plant Density:** 140 plants/m^2	**pH (H_20):** 5.1

Sponsors:

Thanks to Damian O'Keefe for his time and effort which enabled this trial to be conducted.

In-crop Soil N Testing in North East Victoria

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- In crop testing in conjunction with Herbage Nitrogen measurements provided a reliable guide to Nitrogen (N) management.

Aim:

The aim was to undertake in-crop soil testing for available N and accompany this with tiller, dry matter and N uptake measurements. It is hoped that this information will take some of the guesswork out of N application decisions.

Method:

In-crop soil samples were taken to a depth of 60 cm. On the same day tillers were counted on rows of cut sample and the Dry Matter tested for nitrogen analysis. N in crop was calculated from the DM, N% and 36% of total plant N being in the roots.

Results:

Table 4. Results of Crop Monitoring in NE Victoria 2003

Site	**Picola 1**	**Picola 2**	**Euroa**	**Devenish**	**Congupna**
Crop	wheat	Barley	wheat	Wheat	wheat
Sowing date	25th May	26th Apr	3rd Jun	9th May	2nd Jun
Avail Soil N kg/ha)	137	281	-	76	-
Applied N (kg/ha)	32	25	16	40	70
Date of testing	15th Aug	13th Aug	18th Aug	14th Aug	20th Aug
Avail Soil N (kg/ha)	117	49	69	63	126
Tillers/m2	528	895	-	536	708
Dry matter (t/ha)	0.58	3.76	0.8	1.73	0.69
N uptake (kg N/ha) Incl. roots	50	205	63	84	39
N top dressed	Nil	Nil	58	46	50
Yield t/ha	**4.47**	**4.75**	**4.69**	**4.89**	**5.33**
Protein %	**10.9**	**NK**	**11.6**	**12.2**	**11.3**
GSR (Apr-Oct)	330	290	450	380	345+120

Observations and comments:

In crop testing in conjunction with tissue N% and DM at the Picola 1 and 2 sites showed no N to be required for the predicted seasonal yields at the time. Nitrogen was not spread and this decision was sensible. At Euroa, Devenish and Congupna in-crop testing showed a deficiency of N to meet requirements and these paddocks were top dressed. These farmers overestimated final yield, which meant that there was more N applied than would have been necessary. The crops actually used this extra N to achieve the lower yields suggesting that nitrogen efficiencies were lower than 50%. Lower harvest indices due to the mild spring cutting off may have meant more N left in stubble.

Soil testing before sowing and adding a mineralisation estimate to calculate N requirement provided a good guide to the need for topdressing, and to within 20 kg N of the amount required. In crop soil testing without the use of DM and herbage N analysis requires a guess at crop uptake to be meaningful. This in-crop form of N budgeting is useful for crops without pre-sowing soil tests or where seasonal conditions may have altered mineralisation or yield targets.

Sponsors:

Thank you to all of the farmer co-operators, namely Stewart Baxter, Don Hunt, Murray Gilby, Craig Reynolds and Hamish Sinclair.

Picola District Phosphorus Trials

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

Reducing Phosphorus (P) by 40-60% after failed 2002 crops due to drought did not reduce wheat or barley yields on high Phosphorus level sites.

Aim:

To test the Western Victorian theory that reducing phosphorus rates after a drought will not cost yield in crops sown the year after drought, where there is residual fertiliser remaining.

Method:

The three selected sites all showed high levels of P. Combine or air seeder strips were sown where the fertiliser was either cut off or cut back to 40-60% of the regular rate. Wheat and barley were sown and yield was determined from 100 metre strips using the farmer's header and the Department's weigh bin.

Results:

Table 5. Results of Picola District Phosphorus Trials in 2003

Picola 1	**Colwell P = 44**		
Gairdner barley	0 kg P/ha	12 kg P/ha	20 kg P/ha
Yield t/ha	4.76	5.19	5.20
1000 grain weight	40.7	38.9	38.7
Screenings % <2.2	9.2	11.0	11.1
Retention % 2.5<>2.2mm	31.3	36.3	41.5
Protein %	9.8	10.0	10.1
Picola 2	**Colwell P = 41**		
H45 wheat	6 kg P/ha	16.5kg P/ha	
Yield t/ha	2.81	2.81	
1000 grain weight	27	26.8	
Screenings % <2mm	6.3	8.6	
Protein %	10.9	11.3	
Picola 3	**Colwell P = 43**		
Diamondbird wheat	0 kg P/ha	18.5 kg P/ha	
Yield t/ha	2.3	2.92	
1000 grain weight	26.1	25.9	
Screenings % <2mm	5.9	3.5	
Protein %	13.3	12.1	

Observations and comments:

Reduced P rates had little effect on yield even in high yielding situations. The reduced P application theory after drought held true in this region of NE Victoria. Lower P rates had a variable affect on screenings and protein but slightly increased grain size. The use of P resulted in an 8.5% yield increase in a barley paddock and a 21% increase in a wheat paddock compared to the unfertilised area.

Essential Details:

Location: Picola district	**Sowing information:** Sowing date: early May- June Fertiliser: variable	**Paddock history:** 2002 – Failed crops 2001 – variable 2000 – variable	**Soil Type:** Red brown earths Grey duplex loams **pH (H_2O):** 5.4-6.0
Rainfall: Avg GSR: 240mm 2003 GSR: 285-330mm	**Row spacing:** 17.5 cm	**Plot size:** 100 m	**Replicates:** Nil

Sponsors:

Thank you to all farmer co-operators in the Picola District.

2003 Picola State Focus - Follow up of 2002

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- Drought caused 2002 legume plots to fail in August.
- There were no 2003 wheat yield responses due to the different legumes.

Aim:

To assess residual nitrogen following various legume plots (peas, vetch, lentils, chickpeas) and analyse the subsequent wheat yield of Chara wheat.

Method:

Chara wheat was sown by direct drill over the area of the previous year's legume plots. Agronomic measurements were taken during the season. Plot areas were harvested and yields were recorded.

Results:

Table 6. Yield of Chara Wheat in 2003 following 2002 Legume Plots

2002 Legume Varieties	Yield t/ha	1000 grain weight (g)	Screenings %	Protein %
Morava common vetch	5.25	31.6	3.6	10.3
Nugget lentils	4.82	32.8	2.2	10.3
Excell field peas (average of 3 plots)	4.50	32.6	2.0	10.9
Kaspa chickpeas	4.18	29.8	2.1	10.6
Snowpeak field peas	4.06	30.9	3.0	11.1
LSD	**NS**	**NS**	**NS**	**NS**
CV%	**12.0**	**5.5**	**50.3**	**6.5**

NS denotes No Significant Difference ($p<0.05$)

Soil test of pre-sowing nitrogen average = 137 kg/ha

Table 7. Means of Chara Wheat Measurements (3 former Excell Field Pea plots 2002)

	Excell Average
Tillers/m2	528
DM herbage cut (t/ha)	0.585
N uptake (kg/ha)	32

Observations and comments:

The legume plots in 2002 failed due to drought. There was no significant difference in the yield between Chara plots (2003), but overall the yield was very good. This was despite the Dry Matter being low at the Z30 stage, but the tiller numbers were adequate.

The soil type changed across the plot area and may suggest why there was a trend for yield to gradually increase as the soil type improved.

Essential Details:

Location: Picola-Nathalia district	**Sowing information:** Rate: 78 kg/ha Sowing date: 26/5/03 Fertiliser: 30 kg/ha N P blend	**Paddock history:** 2002 –failed legumes	**Soil Type:** Grey duplex loams over clay **pH (H_20):** 6.8
Rainfall: Avg GSR: 240mm 2003 GSR: 330mm	**Row spacing:** 17.5 cm	**Plot size:** 90m x 9.2m	**Replicates:** Nearest neighbour design

Sponsors:

Thanks to the farmer cooperator Murray Gilby.

Picola District Wheat Trial

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- Chara and Whistler yielded well.
- Yitpi, Arrivato and Drysdale had large grain.
- H45 had low screenings despite heavy attack by Stripe Rust.

Aim:

The aim was to test current wheat varieties suitable for growing in the Picola district.

Method:

Single strips of crop were sown with the co-operator's air seeder, harvested by his header and measured using a yield monitor.

Results:

Table 8. Results of the Picola Wheat Trial in 2003

Variety	Sowing 1000 gr wt (g)	Plant count/m^2	Yield (t/ha)	Protein (%)	Screen <2mm (%)	Harvest 1000 gr wt (g)
Whistler	37.9	104	4.54	11.2	2.5	29.2
Chara	38.7	72	4.34	11.3	2.8	30.1
Yitpi	50.9	76	3.74	10.8	0.8	41.6
Wedgetail	29.8	116	3.53	10.8	2.4	32.1
Diamondbird	46.1	100	3.43	10.7	1.7	36.1
Chara (whole paddock)			3.34	10.2		
Drysdale	42.1	92	3.34	9.6	1.2	38.7
H45	36.8	156	3.23	9.6	2.8	32.4
Arrivato Durum	50.0	108	2.96	11.7	2.4	41.4
Bowerbird	43.0	thin	2.23#	11.2	3.8	33.6

Badly damaged by cockatoos

Observations and comments:

The site experienced cockatoo attack after sowing. The Bowerbird plot was most affected with only 1/6th of a decent plot remaining. The low plant densities are a reflection of this damage. Despite the poor start Chara and Whistler performed the best. Screenings were low at this site, even for H45 which had its flag leaf totally yellowed with Stripe Rust.

No fungicide was applied to H45 or any other variety in the trial. Other varieties were only marginally affected by stripe rust. Both Yitpi and the Arrivato Durum had excellent grain size given the dry grain filling period. Most varieties had smaller seed than in 2002.

The large difference between the yield of the farmer's Chara in the paddock and the Chara in the plot could only be explained by a higher yielding area of the paddock where the trial was conducted.

Essential Details:

Location: Picola-Nathalia district	**Sowing information:** Rate: 78 kg/ha Sowing date: 26/5/03 Fertiliser: 30 kg/ha N P blend, 50L/ha UAN	**Paddock history:** 2002 –failed canola 2001 – barley 2000 – barley	**Soil Type:** Grey duplex loams over clay pH (H_20): 5.8
GS Rainfall: Average GSR: 240mm 2003 GSR Apr-Oct: 330mm	**Row spacing:** 17.5 cm	**Plot size:** 40 m x 9.1	**Replicates:** Nil

Sponsors:

Thanks to the farmer cooperator Murray Gilby.

North East Victoria Tissue Testing Results

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- No paddock was severely deficient but Zinc (Zn) and Boron (B) levels were low in some paddocks.

Aim:

To undertake some exploratory tissue testing looking for a trace element deficiency.

Method:

Seven cereal paddocks were tissue tested for nutrient contents using whole samples or youngest emerged blades (YEB). Samples were taken at varying times and growth stages of crops.

Results:

Table 9. Plant Tissue Tests by paddock conducted by Cobram DPI 2003

Location	Crop	Date	Part tested	Growth stage	Zinc Conc. (ppm)	Copper Conc. (ppm)	Boron Conc. (ppm)
Devenish	Wheat	14th Aug	whole	Z33	14.7	5.5	4.6
Katamatite 1	Wheat	25th Sept	YEB	booting	15.4	4.1	10.2
Katamatite 2	Wheat	13th Oct	YEB	Pre-flow	16.2	5.5	14.2
Katandra	Oats	30th July	whole	Z30	94.0	13.0	8.5
Picola 1	Wheat	15th Aug	whole	Z30-31	38.0	7.4	3.9
Picola 2	Barley	13th Aug	whole	Z33	75.9	6.6	6.9
Picola 3	Barley	13th Aug	whole	Z32	45.8	8.0	6.4

Three sites Devenish and Katamatite 1 and Katamatite 2 exhibited zinc concentrations at the lower end of the scale. No sites exhibited classical zinc deficiencies. Two crops however were the variety Diamondbird and exhibited the variety's physiological leaf tipping or necrosis at the leaf tip.

No site was critically low in copper. Interestingly the Katandra site exhibited symptoms of leaf whitening and necrosis, which were similar to that of Copper or Calcium deficiency. Two tests at the 4.5 leaf stage by the farmer and also by DPI at Z30 showed all elements to be sufficient. The crop grew out of the problem and yielded well for hay.

All sites except the Picola 1 site were considered adequate for Boron. Even the result of 3.9 ppm recorded is not regarded as severely deficient.

No paddock was severely deficient but Zinc and Boron were low in some paddocks and warrant further investigation.

Essential Details:

Location: NE Victoria	**Sowing information:** Sowing date: Early May- early June	**Paddock history:** Various	**Soil Type:** Various duplex soils pH (H_20): 5.5-7.0
GS Rainfall: Average GSR: 240-350mm 2003 GSR Apr-Oct: 330-450mm	**Row spacing:** 17.5 cm	**Plot size:** Paddock	**Replicates:** Nil

Sponsors:

Thanks to the farmers for letting us into their paddocks.

North East Victoria Trace Element Trials

Author: Dale Grey and De-Anne Price **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- Some evidence of small Copper responses was confounded by other factors.

Aim:

To see if spraying trace elements would result in grain yield increases.

Method:

Crops were sprayed with trace elements, mainly Copper (Cu). Yield was determined using a weigh bin. The Euroa site was sown to Yitpi wheat and the Katamatite site to Whistler wheat.

Results:

On the 7th August at Euroa a whole plant tissue test indicated Copper (Cu) had a concentration of 5.4 mg/kg, Boron (B) 3 mg/kg and Zinc (Zn) 30 mg/kg. This level of B was potentially low whereas Cu and Zn were good. The farmer applied Cu and B on the paddock in 180 metre strips.

Table 10. Euroa Trace Element Trial*

Treatment	**Yield (t/ha)**	**Screenings %**	**1000 grain weight (g)**	**Protein %**
Control 2 reps	4.69	4.88	40.1	11.6
250 g/ha Cu 30th Aug	4.92	5.73	41.9	11.3
250 g/ha B 30th Aug	4.85	5.57	43.0	11.4
250 g/ha Cu + 250 g/ha B 30th Aug + 250 Cu 22nd Sept 3 reps	4.85	5.04	39.9	11.6
LSD	**0.14**	**NS**	**NS**	**NS**
CV%	**0.8**	**5.8**	**2.4**	**2.3**

*Nearest neighbour design
NS= Not Significant

The results suggest some yield advantage to added Cu or B but are confusing because the Copper plus Boron treatment did not have an additive affect.

Table 11. Katamatite Wheat Copper Treatment + Fungicide Trial*

Treatment	Yield (t/ha)	13/10/03 YEB# tissue test	Protein %
Control	3.98	5.5 mg/kg	12.4
250 g/ha Cu + Fungicide	4.14	6.0 mg/kg	12.7

*unreplicated
#YEB = Youngest Emerged Blade

This trial was sprayed with 250 g/ha of Cu at the third node stage and was also sprayed with fungicide for Stripe Rust control after flowering. Compared to the unsprayed control there was a negligible Cu concentration difference in the flag leaves of the plants three weeks after spraying. The Cu level was considered adequate. A visual yield benefit was apparent but not significant without replication and whether this was from the Copper Treatment or Stripe Rust control is unknown.

Essential Details:

Location:	**Sowing information:**	**Paddock history:**	**Soil Types:**
Euroa and Katamatite	Sowing dates: 3rd June and 5th May	2002 –oats and wheat 2001 – wheat and pasture 2000 – wheat and pasture	Grey duplex & Red brown earth. pH (H_20) 5.1 and 5.5
GS Rainfall: (mm)	**Row spacing:**	**Plot size:**	**Replicates:**
Average GSR 390 & 270 2003 Apr–Oct 450 & 300	17.5 cm	180 x 12 m and paddock	Nearest neighbour design and split paddock

Sponsors:

Thanks to the farmers for leaving control strips and conducting their own trials.

Goldacres full page add

The Third Crop in the Rotation: What are Farmers Using?

Author: Dale Grey **Contact No:** 03 5871 0600

Organisation/Company: Department of Primary Industries, Cobram

Key message:

- Rotations are now dominated by cereal crops and canola has become the most popular break crop.

Aim:

Farmers have been looking for increased confidence in their crop choices and confirmation that changes in their cropping rotations are sustainable in the long term.

Method:

DPI has conducted a survey of 682 paddocks throughout NE Victoria in November since 1998. Because the same paddocks have been checked every year we can start to get a feel for what rotations farmers are using. The dilemma of what to use for the third crops is shown clearly in Table 12.

Results:

Table 12. Land use survey of NE cropping area, comparing 1998 to 2003

Land Use	**1998 %**	**2003%**	**6 yr trend**	**Comments**
Pasture	65.4	54.4	-11.0	Steadily going down
Pasture Hay	5.4	4.7	-0.7	Down
Dryland Lucerne	1.7	4.8	3.1	Slowly going up
Crop	27.5	41.3	13.9	Steadily going up
Cereals	24.6	33.6	9.0	
Cereal Hay	3.2	2.5	-0.7	
Legumes	0.9	1.2	0.3	
Wheat	12.3	16.7	4.4	
Triticale	6.2	8.9	2.7	Slowly increasing
Canola	2.0	6.6	4.6	Steady in 2003, but increased a lot from 1998
Oats	5.4	6.3	1.0	
Barley	0.7	1.6	0.9	Steady but low
Fallow	3.5	0.6	-2.9	Steadily decreasing
Irrigation	4.1	3.2	-0.8	Steady

Since the survey began the amount of grain legumes grown in NE Victoria has remained quite low. Farmers are tending not to use crops such as lupins to extend their cereal rotations and are being forced into using the regular crops available more creatively. This has meant a return to hotter burns of stubble, usage of fungicides and seed dressings and rotating varieties.

Table 13 shows that the practice of following canola with wheat is common and also that wheat on wheat is a common choice. Wheat on wheat has been an increasing trend for a number of years. Of concern is the number of times wheat is used as a pioneering crop after pasture, often with minimal weed control in the pasture phase. Half the wheat grown in NE Victoria is grown with a calculated risk of not getting disease rather than after a break crop.

Table 13. Crop Choice in 2003 given varying Rotations in 2002

PADDOCK USE	2003 CROP CHOICE				
	Wheat	**Canola**	**Triticale**	**Oats**	**Barley**
PASTURE					
Mixed Pasture	21	9	10	10	2
Dryland Lucerne	1	-	-	-	-
Phalaris Pasture	2	-	-	-	-
CROP					
Wheat	31	11	19	5	3
Triticale	9	19	18	7	1
Canola	35	-	6	1	-
Oats	3	2	6	16	-
Barley	2	2	-	3	4
OTHER					
Fallow	2	1	1	-	1
No. of Paddocks	**106**	**45**	**60**	**42**	**11**

Which brings us to the question posed by my title, what are farmers using as the third crop in rotations where wheat follows canola. Usually this would have been the place for a legume to allow for a longer cropping phase. Data from the last four years gives us a guide to what farmers have used to fill this gap in Table 14.

Table 14. Crop Choice following Canola/Wheat in the last 4 Years

Year	**Third crop choice in the following year (number of paddocks)**
1998 Canola /1999 Wheat	5 wheat, 1 canola, 1 oat, 1 pea, 1 mixed pasture
1999 Canola /2000 Wheat	7 wheat, 9 triticale, 2 barley, 2 canola, 2 mixed pasture
2000 Canola /2001 Wheat	10 wheat, 17 triticale, 2 barley, 2 oat, 2 canola 1 mixed pasture.
2001 Canola /2002 Wheat	9 wheat, 7 triticale, 2 oat, 4 canola, 1 pea, 3 mixed pasture, 1 lucerne, 1clover pasture.

Clearly the NSW trend to canola/wheat/canola (not their only rotation, but a popular one) is not being practiced in the majority of cases. The use of a different broadleaf break crop is also uncommon. Wheat has been a common choice but there has been a trend to greater use of triticale in this rotation position especially for 2002. It must be remembered that 2002 was a drought year and this may have influenced decisions for the 2003 crop choice. After getting away with one year, what are farmers choosing to use in the fourth crop position? We are most commonly seeing a return to canola or the same cereal, more commonly triticale after triticale but occasionally three wheat crops in a row after canola!

The paddock survey tells us some interesting information about cropping in general. We have 2/682 paddocks that have been in cereal for the last six years! We have 39/682 (5.7%) paddocks that have been in continuous crop. Thirty percent of our paddocks have been in continuous pasture, but more importantly 70% of NE paddocks have had at least one crop in the last 6 years. It is pleasing from my perspective to see the amount of lucerne slowly increasing; last season was definitely the season for sowing it. Many new lucerne paddocks are being returned to pasture after being in long term cropping. Until we see real confidence in Faba Beans and the release of improved dual resistant (to foliar diseases) varieties, the trend towards cereal dominance with canola break crops being followed by short phases of pasture will continue.

Sponsors:
Thanks to all of the farmers who have participated in the survey. Your input and enthusiasm has been invaluable.

NSW Agriculture & Hi-FERT Zinc Responses in Wheat 2001-2003

Authors: David Harbison & Lisa Cary Castleman **Contact No:** 0408 820 467

Organisation/Company: Hi-FERT**,** Molong and NSW Agriculture, Lockhart

Key message:

- Increasing the levels of fertilizer P above common district rates resulted in increases in yield, however, the response to additional P above 25 kg/ha declined as soil levels rose above 40 ppm (Colwell P).
- No consistent response to Zn application was found across three seasons.

Aims:

- To investigate the response of crop yields to zinc fertiliser on a cropping paddock with marginal zinc levels.
- To investigate if there is a preferred carrier of zinc, MAP or Urea.
- To determine a phosphorus (P) response curve on red clay loam soils in the Lockhart district.

Site Details:

Trial Design

2001

A fully randomised complete block design

3 replicates, plot size = 11m x 1.42m, 7 treatments

The trial area avoided the use of Logran as a pre-emergent herbicide but was otherwise treated as part of the paddock for normal weed control re use of post-emergents.

2002

A fully randomised complete block design

3 replicates, plot size = 11m x 1.42m, 9 treatments

The trial area avoided the use of Logran as a pre-emergent herbicide but was otherwise treated as part of the paddock for normal weed control re use of post-emergents.

2003

A fully randomised complete block design

4 replicates, plot size = 11m x 1.42m, 12 treatments

The trial area was treated as part of the paddock for normal weed control, which included the use of Logran this year. This was due in part to site selection, and an effort to demonstrate a response in a paddock situation described as more likely to demonstrate a response.

Treatment Details 2001

Table 15. Treatment Details in Year One, 2001

Treatment	Product	Nutrient Applied (kg/ha)			
		N	P	S	Zn
1	Urea / MAP	58	25	1.5	0
2	Urea / MAP Zinc-Cote 1.7%	58	25	1.5	2
3	Urea / MAP Zinc-Cote 4%	58	25	1.4	5
4	Urea Zinc 1.9% / MAP	58	25	1.5	2
5	Urea Zinc 4.8% / MAP	56	25	1.5	5
6	Urea Zinc1.0 /MAP Zinc 0.9	58	25	1.5	2
7	Urea / MAP	58	40	1.5	0

Urea or Urea Zinc-Cote® was deep banded under each treatment (depending on zinc requirements) to balance the total nitrogen input to approximately 58 kg/ha. All P was applied with the seed.

The farmer applied 46 units Nitrogen as 100 kg/ha Urea on the 15 September to the paddock and all treatments of the trial.

Table 16. Treatment Details in Year Two, 2002

Treatment	Product	Nutrient Applied (kg/ha)			
		N	P	Zn	Cu
1	NIL (0P)	22.5	0		
2	MAP (15P)	22.5	15		
3	MAP (25P)	22.5	25		
4	MAP (40P)	22.5	40		
5	MAP Zinc-Cote 1.7%	22.5	25	2.0	
6	MAP Zinc-Cote 4.1%	22.5	25	5.0	
7	MAP + Broad acre Zn	22.5	25	0.156	
8	DAP CZ 1.5	22.5	25	2.0	2.0
9	MAP Zinc-Cote 1.1% (40P)	22.5	40	2.0	0.0

All treatments were sown with 22.5 kg nitrogen (N)/ha applied in contact with the seed. Additional N (as Urea) was to be applied via topdressing if the season had been better. All phosphorus (P) was applied with the seed.

Table 17. Treatment Details in Year Three, 2003

Treatment	Product	Nutrient Applied (kg/ha)			
		N	P	Zn	Cu
1	NIL (0P)	22.5	0		
2	MAP (15P)	22.5	15		
3	MAP (25P)	22.5	25		
4	MAP (40P)	22.5	40		
5	DAP Zinc-Cote 1.6%	22.5	25	2.0	
6	MAP Zinc-Cote 4.1%	22.5	25	5.0	
7	MAP + Broadacre Zn	22.5	25	0.156	
8	DAP CZ 1.5	22.5	25	2.0	2.0
9	MAP Zinc-Cote 1.0% (40P)	22.5	40	2.0	
10	R&D Zn	22.5	25	1.5	
11	DAP R&D	22.5	25		(3.4 Mg)
12	MAP + MOP (25 kg/ha)	22.5	25		(25 K)

All treatments were sown with 22.5 kg nitrogen (N)/ha applied in contact with the seed. Additional N (as Urea) was to be applied via topdressing if required. All phosphorus (P) was applied with the seed.

Table 18. 2001 Calender of Events & Observations[1.] **Actual Growing Season Rainfall mm: 208**

Date	Event	Comments [2.]
19/6/01	Trial Sown	Site established well, but late for the variety, Diamondbird. Seeding rate was 60 kg/ha. Sown into ideal moisture.
30/7/01	Spraying weeds	Tank mix of 5 g/ha Ally + 115g/ha Cadence + 500 ml/ha Igran + 500 ml/ha MCPA Amine targeting loosestrife, wireweed and toadrush
31/8/01	Dry matter and tissue sampling	Crop only at early to mid tillering, with some patchy germination in some plots. No visual differences at this early stage.
15/9/01	Topdressing Urea	100 kg/ha across paddock and trial
30/9/01	Tissue Sample	Zinc tests for first set of tissue contaminated. NSW Ag re-sampled the flag leaf.
2/11/01	Field Day (NSW Ag)	General discussion on Zinc, no visual signs of any responses.
4/12/01	Harvest	Good quality grain despite the very dry finish.

[1.] Record of trial management activities or events that may affect the trial
[2]. Note observations relevant to effects of events on trial outcomes

Table 19. 2002 Calender of Events & Observations[1.] **Actual Growing Season Rainfall mm: 123**

Date	Event	Comments [2.]
24/5/02	Trial Sown	Site established well, and on time for the variety, Diamondbird. Seeding rate was 60 kg/ha. Sown into adequate moisture.
15/7/02	Spraying weeds	380 g/ha Achieve targeting wild oats and annual ryegrass
6/8/02	Site inspection and tissue sampling	Site feeling the effects of the drought, Nil P plots detectable due to poor growth.
16/9/02	Dry matter cuts taken	Crop only at mid tillering, some tree effect evident in the first replicate, despite being 25 m away. The Nil P plots were visually behind at this stage.
28/11/02	Harvest	Good protein grain, little of it though!! Screenings averaged 10%.
[1.] Record of trial management activities or events that may affect the trial [2]. Note observations relevant to effects of events on trial outcomes		

Table 20. 2003 Calender of Events & Observations[1.] **Actual Growing Season Rainfall mm: 303**

Date	Event	Comments [2.]
4/6/03	Trial Sown	Site established well, and a little late but still acceptably within the sowing window for the variety, Diamondbird. Seeding rate was 60 kg/ha. Sown into adequate moisture.
28/8/03	Site inspection, dry matter cuts and tissue sampling	Site at mid-tillering, all plots look well, signs of a phosphorus response, with the nil P plots not as developed as the other treatments. Evidence in rep 2 that the potash with the seed may have caused some seedling damage. Moisture level still adequate.
9/10/03	Site inspection	Site continues to grow well. P responses appear evident, as do possible zinc responses at the higher rates.
15/12/03	Harvest	Average to good yields, with high grain protein reflecting the high N status and drier finish of the site. Screenings averaged approximately 10%.
[1.] Record of trial management activities or events that may affect the trial [2]. Note observations relevant to effects of events on trial outcomes		

Actual rainfall recorded (mm) in 2001 at "Culvert Gully" Lockhart											
J	F	M	A	M	J	J	A	S	O	N	D
50	30	35	8	30	25	40	22	30	61	0	0

GSR 2001 - 216 mm (8.6 inches in Apr-Oct)
Total 2001 - 331 mm (13.2 inches)
Effective rainfall = (0.5x(March+April)+(May-November)-110)
Predicted yield = effective rainfall x 0.02
= 2.39 t/ha

Actual rainfall recorded (mm) in 2002 at "Culvert Gully" Lockhart											
J	F	M	A	M	J	J	A	S	O	N	D
0	44	50	18	10	44	11	20	28	10	0	0

GSR 2002 - 141 mm (5.6 inches)
Total 2002 - 235 mm (9.4 inches)
Predicted yield = 0.94 t/ha

Actual rainfall recorded (mm) in 2003 at "Redbank" Lockhart											
J	F	M	A	M	J	J	A	S	O	N	D
5.5	73	0	19.5	17.5	51	69	64.5	28	53.5	25	26

GSR 2003 - 303 mm (12.1 inches)
Total 2003 - 432.5 mm (17.3 inches)
Predicted yield = 4.17 t/ha

Results:

Table 21. Tissue analysis, taken early October, 2001 at the flag leaf stage, Z 41

Treatment		N %	P %	K %	S %	Ca %	B ppm	Cu ppm	Zn ppm
1	Urea / MAP	5.10	0.34	3.19	0.46	0.49	7.72	3.46	18.62
2	Urea / MAP Zinc-Cote 1.7%	4.87	0.31	3.20	0.41	0.46	8.15	3.30	20.25
3	Urea / MAP Zinc-Cote 4%	4.79	0.33	3.40	0.48	0.53	8.36	3.71	22.21
4	Urea Zinc 1.9% / MAP	5.04	0.32	2.96	0.45	0.47	9.44	3.32	22.43
5	Urea Zinc 4.8% / MAP	4.96	0.32	3.11	0.46	0.48	7.89	3.30	21.52
6	Urea Zinc1.0 /MAP Zinc 0.9	4.96	0.31	3.01	0.46	0.45	8.63	3.31	19.02
7	Urea / MAP (40P)	5.25	0.33	3.12	0.44	0.49	7.33	3.27	21.91
Mean		**4.99**	**0.32**	**3.14**	**0.45**	**0.48**	**8.22**	**3.38**	**20.85**
LSD 5%			**0.03**						**2.57**
CV %			**2.3**						**6.9**

Table 22. Tissue analysis, taken 6th August, 2002 at early – mid tillering, Z 23 – 24. The Nil P plots were Z 21 – 22.

Treatment	Product	N %	P %	K %	S %	Ca %	B ppm	Cu ppm	Zn ppm
1	NIL (0P)	5.17	0.21	4.69	0.46	0.25	5.74	7.85	32.93
2	MAP (15P)	5.45	0.30	4.89	0.46	0.23	6.12	6.97	25.52
3	MAP (25P)	5.57	0.32	4.75	0.45	0.27	7.37	7.22	25.48
4	MAP (40P)	5.70	0.38	4.90	0.45	0.23	5.46	6.72	30.12
5	MAP Zinc-Cote 1.7%	5.58	0.34	4.90	0.45	0.24	6.17	7.39	25.17
6	MAP Zinc-Cote 4.1%	5.43	0.32	4.91	0.44	0.23	6.15	6.56	26.74
7	MAP + Broadacre Zn	5.58	0.33	4.86	0.43	0.23	5.50	6.83	24.71
8	DAP CZ 1.5	5.45	0.33	4.86	0.44	0.22	6.92	6.97	23.56
9	MAP Zinc-Cote 1.1% (40P)	5.62	0.38	4.98	0.46	0.23	6.92	6.87	27.86
Mean		**5.51**	**0.32**	**4.86**	**0.45**	**0.24**	**6.26**	**7.04**	**26.90**
LSD 5%		**0.28**	**0.028**					**1.2**	**6.6**
CV %		**2.9**	**4.9**					**9.9**	**14.2**

Table 23. Tissue analysis, taken 28th August, 2003 at mid tillering, Z 23 – 24.

Treatment	Product	N %	P %	K %	S %	Ca %	B ppm	Cu ppm	Zn ppm
1	NIL (0P)	5.45	0.36	5.00	0.41	0.31	6.73	8.28	31.9
2	MAP (15P)	5.15	0.39	4.70	0.40	0.24	6.77	8.37	26.1
3	MAP (25P)	5.25	0.42	4.78	0.40	0.24	7.06	8.52	20.4
4	MAP (40P)	5.24	0.43	4.70	0.40	0.26	7.32	9.42	24.6
5	DAP Zinc-Cote 1.6%	5.41	0.41	4.78	0.40	0.28	7.82	8.34	26.7
6	MAP Zinc-Cote 4.1%	5.09	0.38	4.96	0.40	0.29	8.39	8.61	25.7
7	MAP + Broadacre Zn	5.18	0.40	4.76	0.40	0.25	7.33	8.30	24.3
8	DAP CZ 1.5	5.39	0.43	4.87	0.41	0.26	7.84	9.03	26.4
9	MAP Zinc-Cote 1.0% (40P)	5.28	0.44	4.96	0.40	0.29	7.57	8.46	24.0
10	R&D Zn	5.25	0.39	4.87	0.39	0.26	8.12	7.98	25.1
11	DAP R&D	5.41	0.43	4.85	0.40	0.27	8.11	9.03	28.5
12	MAP + MOP (25 kg/ha)	5.25	0.41	4.88	0.41	0.30	8.61	8.73	28.5
Mean		**5.28**	**0.41**	**4.84**	**0.40**	**0.27**	**7.64**	**8.59**	**26.1**
LSD 5%			**0.045***						**9.8***
CV %			**7.1**						**25**

* Indicates a significant effect

Table 24. Dry Matter, Yield and Protein Results in 2001

Treatment		Dry Matter* (t/ha)	Yield (t/ha)	Yield % of Nil Zinc	WUE** (kg/mm)	Protein (%)
1	Urea / MAP	0.61	3.21	100	26.9	15.0
2	Urea / MAP Zinc-Cote 1.7%	0.70	3.43	107	28.7	14.6
3	Urea / MAP Zinc-Cote 4%	0.72	3.30	103	27.6	14.7
4	Urea Zinc 1.9% / MAP	0.92	3.50	109	29.3	14.5
5	Urea Zinc 4.8% / MAP	0.61	3.44	107	28.8	14.6
6	Urea Zinc1.0 /MAP Zinc 0.9	0.85	3.32	103	27.8	14.7
7	Urea / MAP (40 P)	0.68	3.59	112	30.0	15.0
Mean		**0.73**	**3.40**			**14.7**
LSD 5%		**0.31**	**0.48**	**14.1**		**0.51**
CV %		**24**	**8**			**2**

* Dry matter cuts taken at early tillering, crop establishment was patchy.
** Water use efficiency = ((0.5 x (March + April)) + GSR (M-N) – 110mm) x 0.02 which for 2001 equals 2.39 t/ha

Table 25. Dry Matter, Yield and Protein Results in 2002

Treatment	Product	Dry Matter (t/ha)	Yield (t/ha)	Yield % of Nil Zinc (25P)	Protein (%)
1	NIL (0P)	1.05	1.17		12.5
2	MAP (15P)	2.69	1.62		12.7
3	MAP (25P)	2.80	1.50	100	12.8
4	MAP (40P)	3.08	1.72		12.3
5	MAP Zinc-Cote 1.7%	2.80	1.32	100	13.0
6	MAP Zinc-Cote 4.1%	3.08	1.92	128	12.3
7	MAP + Broadacre Zn	2.85	1.48	99	13.0
8	DAP CZ 1.5	3.10	1.75	117	12.3
9	MAP Zinc-Cote 1.1% (40P)	3.05	1.77		12.1
Mean		**2.72**	**1.58**		**12.5**
LSD 5%			**0.28**	**17.7**	**0.67**
CV %			**10.3**		**3.1**

** Water use efficiency = ((0.5 x (March + April)) + GSR (M-N) – 110mm) x 0.02 which for 2002 predicted a grain yield of 0.94 t/ha

Table 26. Dry Matter, Yield, Protein and Grain Weight Results in 2003

Treatment	Product	Dry Matter (t/ha)	Yield** (t/ha)	Yield % of Nil Zinc (25P)	Protein (%)	Grain Weight (kg/hl)
1	NIL (0P)	0.49	2.82		13.82	69.0
2	MAP (15P)	0.99	3.17		13.02	71.0
3	MAP (25P)	1.13	3.31	100	13.35	72.8
4	MAP (40P)	1.29	3.37		12.75	73.0
5	MAP Zinc-Cote 1.7%	1.25	3.21	97	13.40	
6	MAP Zinc-Cote 4.1%	1.38	3.31	100	12.92	
7	MAP + Broadacre Zn	1.18	3.45	105	13.15	
8	DAP CZ 1.5	1.18	3.31	100	12.80	
9	MAP Zinc-Cote 1.1% (40P)	1.54	3.28		12.72	
10	R&D Zn	1.10	3.19	96	13.52	
11	DAP R&D	1.45	3.16		13.47	
12	MAP + MOP (25 kg/ha)	1.00	3.22		13.10	
Mean		**1.16**	**3.23**		**13.17**	**71.5**
LSD 5%		**0.35***	**0.37***	**11**	**1.13**	**2.1***
CV %		**19**	**7.8**		**5.7**	**1.8**

** Water use efficiency = ((0.5 x (March + April)) + GSR (M-N) – 110mm) x 0.02, which for 2003 predicted grain yield to be 4.17 t/ha

Trial summary:

Main Findings in 2001

Despite the main aim being to investigate zinc responses on red acid soils, the best finding here was the response to phosphorus. The results reflect the marginal soil test P (Colwell 29) as being insufficient to satisfy the crops requirements, and that applications of P above district practice are proving economical. The tissue tests indicate that none of the plots were deficient in zinc, however it was encouraging to report that all zinc treatments resulted in higher plant tissue zinc than the equivalent non zinc treatment.

No dry matter responses could be detected due to the variability in plant emergence, especially when the dry matter cuts were taken at early - mid tillering.

Yield responses to applied zinc appeared to indicate a response, although increasing the amount of zinc from 2 to 5 kg/ha did not increase the yields. Both yields were above the nil zinc treatments. Protein levels were not affected by the application of Zinc.

Significant Outcomes in 2001

Table 27. Composite Grain Yield Summary

Applied Phosphorus Rate (kg/ha)	0	25	40
Yield (t/ha)	n/a	3.21	3.59
Applied Zn Rate (kg/ha) at 25 kg P/ha	0	2	5
Yield (t/ha)	3.21	3.42	3.37
LSD 5%	0.48		

The only significant result in this trial was the significant increase in plant tissue zinc ($p<0.05$) to applied zinc. Where zinc was applied, plants took up greater amounts, however did not increase yield. A response to phosphorus may have been detectable had a nil P treatment been applied. The difference between the two P treatments was not significant, although the higher P treatment did yield 0.38 tonne/ha more. All plant tissue levels measured were above critical levels indicated for a response. Grain protein was not significantly different.

Main Findings in 2002

Tissue results:

A significant increase in tissue P occurred with the increased rates of P applied. This is an interesting outcome given the soil P level of 40 mg/kg Colwell. This soil P level would normally be considered adequate, however visually; the Nil P plots were very distinct and lagged behind all season. Adequate levels at Z 23 – 24 are from 0.32-0.38 for the 5 leaf stage and 0.24-0.30 for the 6 leaf stage. The nil P plots at Z 21 – 22 should be up in the range 0.44-0.47.

Importantly, the addition of P resulted in a significant increase in tissue N, where the highest tissue N levels were found at the highest P rates. Nitrogen levels were all greater than 5%, indicating nitrogen was not limiting the crop, despite only having had 22.5 kg N/ha applied.

Zinc levels in the tissue were again within the adequate range (17-25 mg/kg) and no significant increase in zinc levels were achieved where zinc was applied. Where Nil P was applied, there was actually a significant increase in tissue zinc; however this is purely a function of the reduced amount of dry matter.

Copper levels appeared adequate (> 2.1 mg/kg), and boron, on limited information, also appeared within the adequate range (5-25 mg/kg).

Dry matter results:

Significant increases in dry matter were achieved with the application in P. No increases resulted from the application of zinc.

Yield results:

Significant responses to applied P were achieved, which again reflects the difficulty in interpreting soil P levels. The only zinc response, was a significant increase in yield to the application of 5 kg/ha of zinc. Whilst the result is significant, it must be treated with caution. In 2001, neither the 2 nor 5 kg Zn/ha treatments gave a zinc response, and perhaps this result is due to the much lower yields achieved because of the drought conditions. Without an increase in the tissue zinc levels to support the yield increase, it would be difficult to repeat this result in a ‘normal’ season.

Significant Outcomes in 2002

Table 28. Composite Grain Yield Summary

Applied Phosphorus Rate (kg/ha) (Nil Zn)	0	15	25	40
Yield (t/ha)	1.17	1.62	1.50	1.72
Applied Zn Rate (kg/ha) at 25 kg P/ha	0		2	5
Yield (t/ha)	1.5		1.32	1.92
LSD 5%	0.28			

Two significant ($p<0.05$) results occurred in this trial, the first to the application of 5 kg/ha of zinc, and the second to applied phosphorus. Grain proteins were not significantly different.

Main Findings in 2003

Tissue results:

A significant ($p<0.05$) increase in tissue P concentration occurred with the increased rates of P applied. This again is an interesting outcome given the soil P level of 48 mg/kg Colwell P. This soil P level would normally be considered adequate, however visually the nil P plots were detectable for most of the season. Adequate tissue P concentrations for Z 23 – 24 are from 0.32-0.38 for 5 leaf and 0.24-0.30 for 6 leaf. The nil P plots at growth stage Z 21 – 22 should be up in the range 0.44-0.47.

Nitrogen (N) levels were all greater than 5%, indicating N was not limiting the crop, despite only having had 22.5 kg N/ha applied at sowing.

Zinc levels in the tissue were again within or above the adequate range (17-25 mg/kg). A huge variation in tissue Zn concentrations were observed, resulting in a disappointing CV of 25%. Despite this, the nil P treatment recorded a significantly higher tissue Zn when compared to the 25 kg P/ha treatment. This result was also observed last year, where lack of dry matter production, due to P deficiency, resulted in elevated trace element concentrations. No significance in Zn concentrations was observed where P was applied either with or without Zn.

Copper (Cu) levels appeared adequate (> 2.1 mg/kg), and boron (B), on limited information, also appeared within the adequate range (5-25 mg/kg).

Dry matter results:

Significant ($p<0.05$) increases in dry matter were achieved with the application in P. No increases resulted from the application of zinc.

Yield, protein and grain weight results:

Significant ($p<0.05$) responses to applied P at rates of 15 kg/ha of P and above were achieved despite the soil P level (48 ppm Colwell P) indicating that P responses should have been minimal. No yield responses were achieved by the application of zinc at any rate.

Protein levels were all quite high for the Lockhart district, with no significance being detected due to any of the treatments. The protein levels were indicative of the good nitrogen levels measured in the soil. Grain weight overall showed no significant effects (5% lsd 4.6, CV 4.1%) but for the P response treatments (treatments 1 – 4), there was a huge reduction in the CV and consequently a highly significant response to the rate of P applied (5% lsd 2.1, CV 1.8%). This result supports one of the many known roles of phosphorus in the plant, by enabling greater efficiency in the grain filling process of converting moisture and energy into carbohydrates.

Significant Outcomes in 2003

Table 29. Composite Grain Yield Summary

Applied Phosphorus Rate (kg/ha) (Nil Zn)	0	15	25	40
Yield (t/ha)	2.82	3.17	3.31	3.37
Applied Zn Rate (kg/ha) at 25 kg P/ha	0		2	5
Yield (t/ha)	3.31		3.26	3.31
LSD 5%	0.37			

Only one significant ($p<0.05$) yield result occurred in this trial, that being to increased rates of phosphorus at 25 kg/ha of P and above. Grain proteins were not significantly different.

Three year observations

After completing three successive years of zinc and phosphorus trials, some notable conclusions have come to light.

Zinc

There has only been one significant ($p<0.05$) grain yield response to applied zinc. This was achieved in the dry year of 2002, when 5 kg/ha of Zn was applied with the seed at sowing. Whilst soil testing for trace elements has it's limitations, it may not be so coincidental that this one result came from the trial site with the lowest soil Zn level of the three sites over the years (Table 4).

Table 30. Zinc responsiveness over the three years of trials

Year / Site	Soil pH (CaCl2)	Soil Zinc (DTPA)	Significance of Zinc response/comment
2001 - Trevor Lehmann	4.8	0.46	Non significant. All treatments that applied Zn showed an increasing yield trend
2002 - Trevor Lehmann	5.3	0.26	P<0.05. Drought year, that resulted in a 0.42 t/ha (28%) increase in yield over the "non-zinc" equivalent rate of P when applied at 5 kg Zn/ha.
2003 – Geoff Lane	5.5	0.35	Non significant. No trends

Phosphorus

In each of the last two years, a significant ($p<0.05$) response to P has been achieved, on soils with soil P levels considered adequate to high. The results of 2001 indicated the same would have been achieved had a P response curve been targeted (Table 5). What is evident from Table 5 is that the response to additional P above 25 kg/ha declines as measured soil P concentrations increase above 40 ppm (Colwell P).

Table 31. Phosphorus responsiveness over the three years of trials

Year / Site	Soil pH (CaCl2)	Soil P (Colwell)	Significance of Phosphorus response/comment
2001 - Trevor Lehmann	4.8	29	Non significant. P treatments reduced due to lack of space. Yield increase of 0.38 t/ha (12%) achieved by raising P rates from 25 to 40 kg P/ha.
2002 - Trevor Lehmann	5.3	40	P<0.05. Drought year, that resulted in a 0.45 t/ha (38%) increase in yield by applying 15kg P/ha, a 0.33 t/ha (28%) increase in yield by applying 25kg P/ha, with another 0.22 t/ha (15%) achieved by increasing the P rate to 40 kg P/ha.
2003 – Geoff Lane	5.5	48	P<0.05. Average year, that resulted in a 0.49 t/ha (17%) increase in yield by applying 25kg P/ha, with another 0.06 t/ha (2%) achieved by increasing the P rate to 40 kg P/ha. The latter increase in P rate is not considered economic.

Benefit to Farmers

The P response indicates that higher yields and profit are obtainable by farmers if they are using less than 25 kg P/ha. Assuming a price for wheat at $200/tonne (D. Harbison), the return on investment in P fertilizer (up to 25 kg P/ha) on high P soils (Colwell P > 40 ppm) is at least $2 for each $1 spent (Lockhart 2003), whilst on soils lower in P concentration (Colwell P < 25 ppm), this return can increase to $6 and $7 for each $1 spent (Alectown 2000), but usually returns approximately $4 to $5 for each $1 invested in P.

Zinc responses are possible, and the return on investment in Zn can be substantial. However, these three years of data have failed to find consistent responses on the red acid soils of the Lockhart district. Use of Zn on these soil types could, at best, be described as “insurance”, or perhaps the low rates could be said to be replacing what is annually removed. Other soil types may well be responding to applied Zn, and farmers should use tissue testing as the main guide for trace element responsiveness. After all, it is the plant that responds, not the soil!

Recommended Action following 2001 results

Zinc is one nutrient that will increase in its demand as nutrient removal continues. Defining the yield benefits from applying zinc in the Lockhart region has proved difficult. A more robust trial design needs to be implemented. This site’s soil zinc level indicated a possible response, and that’s exactly what was achieved.

The significant increase in plant tissue zinc is a clear indication that zinc applied as an oxide as a coating is a very satisfactory method of applying zinc.

The P response indicates that higher yields are obtainable, and that increasing P rates could be economic. The optimal level will need to be defined.

Recommended Action following 2002 results

Defining the yield benefits from applying zinc in the Lockhart region has proved difficult. This site's soil zinc level of 0.26 mg/kg indicated a zinc response would be likely, however, this was only achieved, in the drought year that it was, at the highest zinc rate of 5 kg/ha. Zinc responses are possible, but better seasons and more reliable responses will determine the increased use of zinc.

The P response indicated again that higher yields are obtainable, and that increasing P rates could be economic.

Recommended Action following 2003 results

Defining the yield benefits from applying zinc to the red, acid soil types in the Lockhart region has proved difficult. One response from up to 15 different Zn treatments, while promising, is hardly convincing that there should be widespread use to address a 'hidden hunger' or existing, unrecognised deficiencies.

The short term management option may be to sample the plant and apply foliar Zn if required.

Essential Details:

Location	**Lockhart**	**Co-operators**	Trevor & Rose Lehmann "Culvert Gully" Lockhart NSW 2656 in 2001 and 2002 Geoff & Liz Lane "Redbank" Lockhart NSW 2656 in 2003
GPS		**Phone**	02 6920 5344 Trevor 02 6929 5257 Geoff

Site Details 2001: Lockhart Soil Type: Red Loam

Annual Rainfall mm:		331		Growing season rainfall mm:			216	
Paddock History								
Year	**Crop / Pasture**	**Yield T/ha**	**Stocking Rate DSE**	**Nutrients Applied (kg/ha)**				
				N	**P**	**K**	**S**	**Other**
2000	Canola	2.0		79	22	0	80	
1999	Wheat	3.9		10	22	0	1	
Notes (crop, grazing management etc.): Lime was applied at 2 t/ha prior to the canola in 2000. Gypsum was used as the S source for that crop. The rate was 0.5 t/ha. Average annual rainfall for site is 450 mm.								

Site Details 2002: Lockhart Soil Type: Red Loam

Annual Rainfall mm:		235		Growing season rainfall mm:			123	
Paddock History								
Year	**Crop / Pasture**	**Yield T/ha**	**Stocking Rate DSE**	**Nutrients Applied (kg/ha)**				
				N	**P**	**K**	**S**	**Other**
2001	Canola	1.5	-	63	17	0	75	
2000	Wheat	5.0	-	54	17	0	1	
Notes (crop, grazing management etc.):								

Site Details 2003: Lockhart Soil Type: Red Clay Loam

Annual Rainfall mm:		432		Growing season rainfall mm:			303	
Paddock History								
Year	**Crop / Pasture**	**Yield T/ha**	**Stocking Rate DSE**	**Nutrients Applied (kg/ha)**				
				N	**P**	**K**	**S**	**Other**
2002	Canola	0.5	NA	11	23		120	Lime 2 t/ha
2001	Lucerne		10					
Notes (crop, grazing management etc.): 2002 Drought year had 128 mm growing season rainfall and 315 mm in total								

Last Soil Test Results Depth: 0-10 cm Year: 2001

Test	**Org. C %**	**P[1] mg/kg**	**K mg/kg**	**S mg/kg**	**pH H_2O**	**PH $CaCl_2$**	**Cu (DTPA) mg/kg**	**Zn (DTPA) mg/kg**
Result	1.24	29	560	36.5	5.0	4.8	0.37	0.46
Status	Adq	Marg	Adq	High	Strongly acidic	Strongly acidic	Marg	Marg
Test	**CEC %**	**Ca %**	**Mg %**	**Na %**	**S (kg/ha) 0-10**	**SALT**	**N (kg/ha) 0-10**	**N (kg/ha) 10-60**
Result	6.9	67	10	1.3	47	0.223	81	na
Status	Marg	Adq	Marg	Adq	Adq	Marg	Adq	

[1]. P test is Colwell, Olsen P was 17.9

Phosphate Buffering Index 47.1

Last Soil Test Results Depth: 0-10 cm Year: 2002

Test	Org. C %	P[1] mg/kg	K mg/kg	S mg/kg	pH H_2O	pH $CaCl_2$	Cu (DTPA) mg/kg	Zn (DTPA) mg/kg
Result	1.75	40	406	16.1	6.3	5.3	0.68	0.26
Status	Adq	Adq	Adq	High	Acidic	Acidic	Adq	Low
Test	**CEC %**	**Ca %**	**Mg %**	**Na %**	**S (kg/ha) 0-10**	**SALT**	**N (kg/ha) 0-10**	**N (kg/ha) 10-60**
Result	10.9	57	28	5.5	20.8	0.105	35.1	na
Status	Adq	Marg	High	Elev	Adq	Adq	Marg	
[1]. P test is Colwell, Olsen P was 18.1								
Phosphate Buffering Index 70.7								

Last Soil Test Results Depth: 0-10 cm Year: 2003

Test	Org. C %	P[1] mg/kg	K mg/kg	S mg/kg	pH H_2O	pH $CaCl_2$	Cu (DTPA) mg/kg	Zn (DTPA) mg/kg
Result	2.08	48	385	30.9	6.2	5.5	1.07	0.35
Status	Adq	Adq	Adq	High	Acidic	Acidic	Adq	Low
Test	**CEC meq/100 gms**	**Ca %**	**Mg %**	**Na %**	**S (kg/ha) 0-10**	**SALT**	**N (kg/ha) 0-10**	**N (kg/ha) 10-60**
Result	14.3	62.3	26.2	4.8	43	0.237	92	na
Status	Adq	Adq	Elev	Elev	Adq	Adq	Adq	
[1]. P test is Colwell, Olsen P was 23.9								
Phosphate Buffering Index								

Acknowledgments

Hi-Fert would like to thank the co-operators in 2001 and 2002, Trevor & Rose Lehmann at "Culvert Gully" and in 2003, Geoff & Elizabeth Lane at "Redbank", Lockhart for the provision of the trial sites and NSW Agriculture, Lisa Cary Castleman, Chris Powell and Ken Giddings, for the initiation, sowing, management and harvesting of the trial.

Further information :

David Harbison (0408 820467) or Lisa Cary Castleman (02 6920 5177).

NSW Agriculture Results for Sclerotinia Trials in 2003

Authors: Tamrika Hind-Lanoiselet, Fleur Lewington, Kerry Wratten and Gordon Murray.

Contact: Ph 02 6938 1608 Email: tamrika.hind@agric.nsw.gov.au

Organisation/company: NSW Agriculture, Plant Pathology Unit, Wagga Wagga

Key messages:

- Carefully consider the costs, possible yield and likelihood of Sclerotinia in canola before applying fungicides.
- In 2003 many fungicide treatments reduced disease development. However, at most sites there was no significant difference in yield as the disease levels were too low.
- The interaction between yield and the development of Sclerotinia stem rot is not fully understood and more work is being conducted in this area by NSW Agriculture.

Introduction:

Sclerotinia stem rot is a disease that attacks many species of broadleaf plants, including canola, peas, beans, sunflowers and lupins. The disease occurs sporadically when environmental conditions are favourable. It is caused mainly by the fungus *Sclerotinia sclerotiorum.* Prolonged humid (wet) conditions during flowering of canola favour disease development and yield losses as high as 24% (2001) have been recorded under Australian conditions.

The frequency and severity of Sclerotinia on canola is poorly understood. While the last 2 seasons (2002 and 2003) have not been favourable for disease development, the seasons from 1998 to 2001 were more conducive for Sclerotinia development and it was recognised as an important canola disease in the high rainfall zones of southern NSW.

Disease cycle

Sclerotia remain viable for many years in the soil. When weather conditions are favourable, the sclerotia germinate producing small stick-shaped structures called stipes. Then small mushroom-shaped structures (apothecia) are produced on the stipes. Apothecia produce thousands of air-borne spores that can be carried several kilometres by the wind.

Spores land on canola petals and when the petals fall at the end of flowering, they lodge in the lower canopy of the crop. The spores germinate, and using the petal as a source of nutrient, the fungal mycelium grows and invades the canola plant. The canola flowering period is therefore the critical time for Sclerotinia infection. Germination of the spores and infection is enhanced by wet weather at flowering.

Fungicides

Yield losses in crops overseas are reduced by the timely application of fungicides during flowering. In Australia, Rovral® Liquid fungicide is currently registered for control of Sclerotinia in canola at 2 litres/ha. Other fungicides are currently being considered for registration.

Due to the sporadic nature of stem rot it is important to determine the economic feasibility of any fungicide application. It has been considered uneconomical to apply fungicides routinely, and to be effective they need to be applied before the plant becomes infected.

Current label recommendations for the control of *S. sclerotiorum* in canola are to apply fungicide at between 20 and 50% flowering. The best timing for protection is during flowering when the petals have just begun to senesce. Before applying a fungicide, consider the current price of both chemical and canola to determine the viability of Sclerotinia control.

Results from Sclerotinia fungicide trials for 2003:

In order to better define the most effective stage of flowering for fungicide application 10 small plot trials were conducted in 2003 (Table 32). Each trial had two varieties of canola (Hyola 60 and Rainbow) and four fungicide treatments using 2L/ha of Rovral liquid fungicide. The treatments included:

- a control
- an early fungicide application (at 20 – 30 % flowering)
- a late fungicide application (2 weeks after early application)
- an early plus a late fungicide application.

In all locations except Tamworth high percent petal infestations were recorded before the early fungicide application. Very little stem rot was recorded in the plots before harvest.

Disease development of *S. sclerotiorum* is favoured by wet, humid conditions. After the early fungicide treatments, weather conditions became unfavorable for disease development.

Fungicide treatments at Rutherglen, Gerogery, Henty, Wallendbeen, Wombat, Greenethorpe and Tamworth reduced disease development. In 2003, the early application of fungicide was usually the most effective for reduction in disease development. When both of the varieties were combined at the Temora site, a reduction in disease development was also observed (see below for extra details on each site). However, disease levels in most locations were too low to affect yield.

There was no significant yield difference between any of the fungicide treatments conducted in 2003 when both varieties were combined. However, at Rutherglen and Gerogery a significant yield difference was observed when the varieties were separated. In Rutherglen the early fungicide application significantly increased the yield in Rainbow over the control by 0.44 t/ha and in Gerogery the late fungicide application significantly increased the yield of Hyola 60 over the control by 0.46 t/ha.

There was very little economic benefit from applying fungicides in 2003 because the percent of stem rot was extremely low; 1.9% stem rot was the highest recording in any control plot (Table 32). Thus, carefully consider the costs, possible yield and likelihood of Sclerotinia in canola before applying fungicides.

Table 32. Locations and some treatment results from 10 trials conducted in 2003. Treatment results include: % petal infestation taken at 20-30 % flowering; % stem rot in the control plots; and average number of plants with stem rot in the control plots.

Location	Percent petal infestation (early)	Percent stem rot	Number of plants with stem rot/plot
Rutherglen	58.5	0.4	4.5
Gerogery	61.9	0.4	2.8
Henty	98.8	1.9	18.2
Temora	68.5	0.4	1.3
Dirnaseer	86.5	0.02	0.2
Wallendbeen	77.5	0.1	1
Wombat	98.1	0.3	2.8
Thuddungra	87.1	0.3	0.9
Greenethorpe	97.9	0.2	0.5
Tamworth	1.8	0.8	9.3

Acknowledgements:

Thank you to the NSW Agriculture Crop Evaluation units for sowing and managing trials, Peter Hamblin from Agritech for sowing and managing trials, co-operator growers for enabling us to have trials on their properties; and the GRDC for providing the funds for this project.

Individual Site Results:

Rutherglen – Stem rot incidence and yield results

Stem rot incidence

Percent stem rot at the Rutherglen site was extremely low, with a maximum of 0.6 % stem rot for the Rainbow control (Figure 1). The percent of stem rot in Rainbow was significantly reduced with all fungicide applications. Stem rot in Hyola 60 was not reduced with any fungicide application, with the late spray having significantly more Sclerotinia than the control.

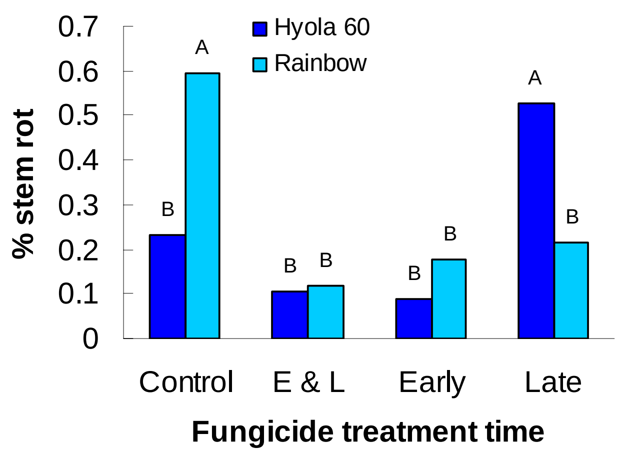


Figure 1. % Stem rot at Rutherglen for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD = 0.2780.

Yield

The low incidence of stem rot resulted in only one variety having a yield response for fungicide treatments at the Rutherglen site. Rainbow had a significantly higher yield than Hyola 60 (data not presented). For Hyola 60 there was no significant yield difference between any of the fungicide treatments. However, the early fungicide application significantly increased the yield in Rainbow over the control by 0.44 t/ha (Figure 2). When data from both varieties were combined there was no significant yield difference between any of the fungicide treatments (data not presented).

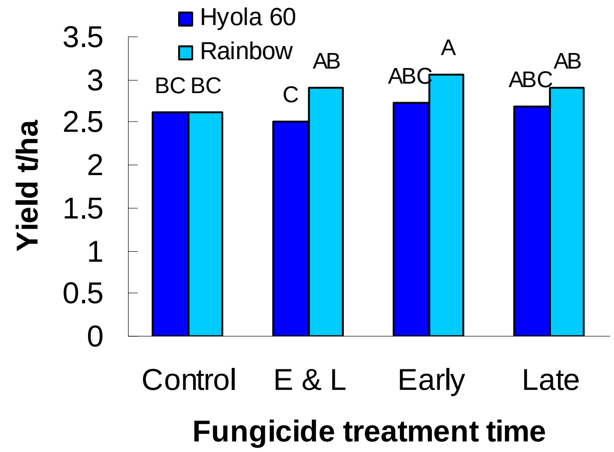


Figure 2. Yield at Rutherglen for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD= 0.3955.

Gerogery – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Gerogery site was extremely low, with a maximum of 0.4% stem rot for the Hyola 60 and Rainbow controls (Figure 3). The percent of stem rot in Hyola 60 and Rainbow was significantly reduced with all fungicide applications.

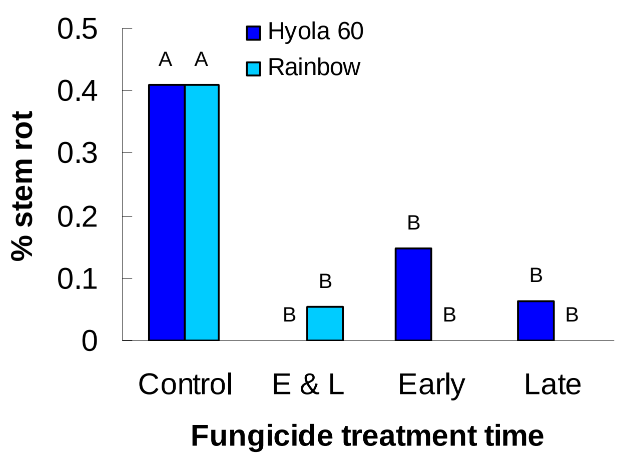


Figure 3. Percent stem rot at Gerogery for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.3918.

Yield

The low incidence of stem rot resulted in only one variety having a yield response for fungicide treatments at the Gerogery site. Hyola 60 had a significantly higher yield than Rainbow (data not presented). For Rainbow there was no significant yield difference between any of the fungicide treatments. However, the late fungicide application significantly increased the yield of Hyola 60 over the control by 0.46 t/ha (Figure 4). When the data from both varieties were combined there was no significant yield difference between any of the fungicide treatments (data not presented).

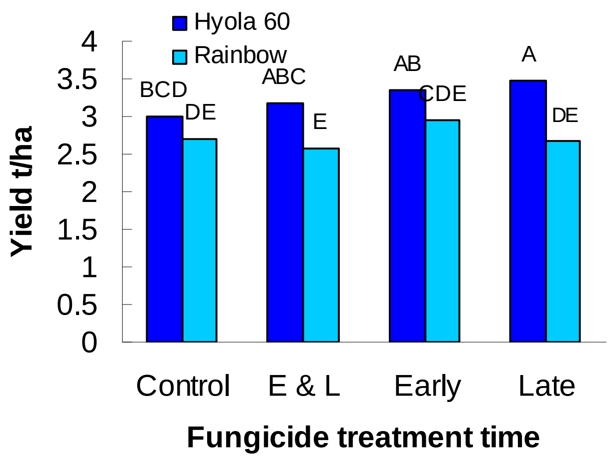


Figure 4. Yield at Gerogery for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD= 0.3811.

Henty – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Henty site was very low with a maximum of 1.97% (Figure 5). The early application of fungicide significantly reduced the percent of stem rot in Hyola 60 and Rainbow. Stem rot in Hyola 60 was also significantly reduced by the early & late fungicide application.

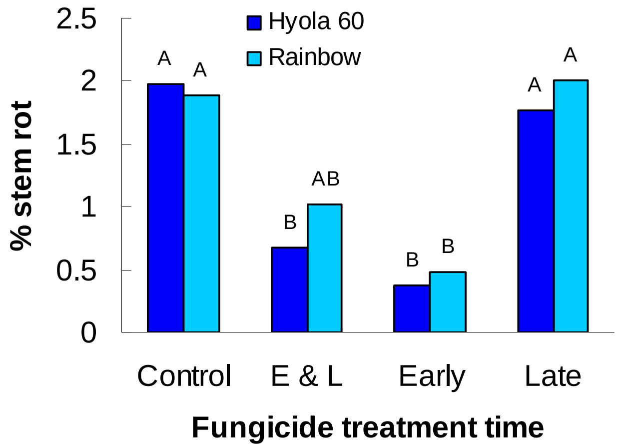


Figure 5. % Stem rot at Henty for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=1.047.

Yield

The low incidence of stem rot resulted in no significant yield difference between the fungicide treatments at the Henty site (Figure 6). Hyola 60 had a significantly higher yield than Rainbow (data not presented).

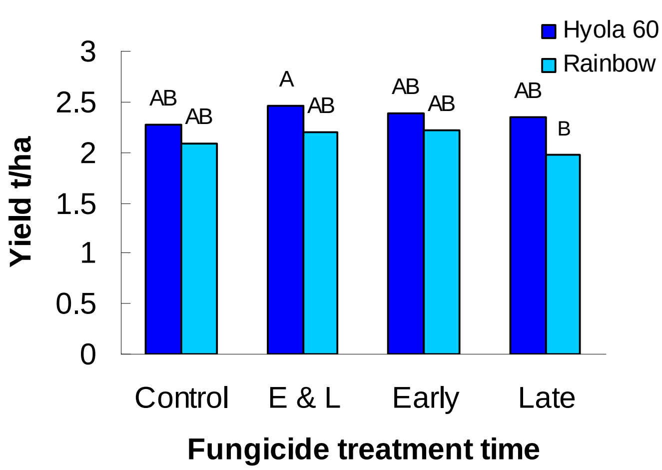


Figure 6. Yield at Henty for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.4261.

Temora – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Temora site was extremely low with a maximum of 0.7% (Figure 7). There was no significant effect of fungicide treatment on percent stem rot in each variety. However, when data from both varieties were combined the early and early & late treatments had significantly less stem rot than the control (data not presented).

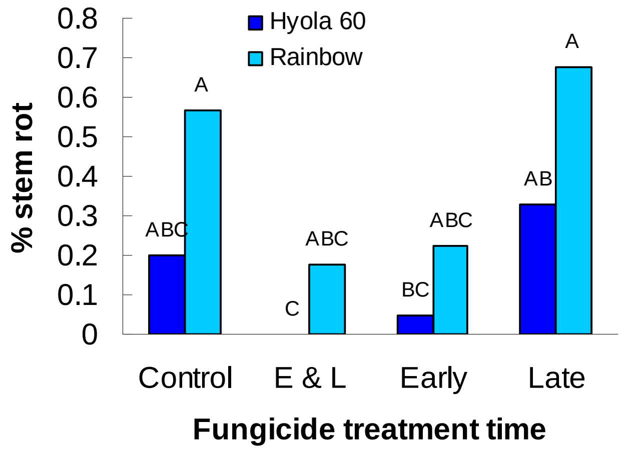


Figure 7. Percent stem rot at Temora for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD = 0.4424. Note: LSD taken from the square root of % stem rot data, data presented above is not square root data.

Yield

There is no yield data for the Temora site as it was damaged by a hailstorm before harvest.

Dirnaseer – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Dirnaseer site was extremely low, with a maximum of 0.08% (Figure 8). There was no significant difference between treatments.

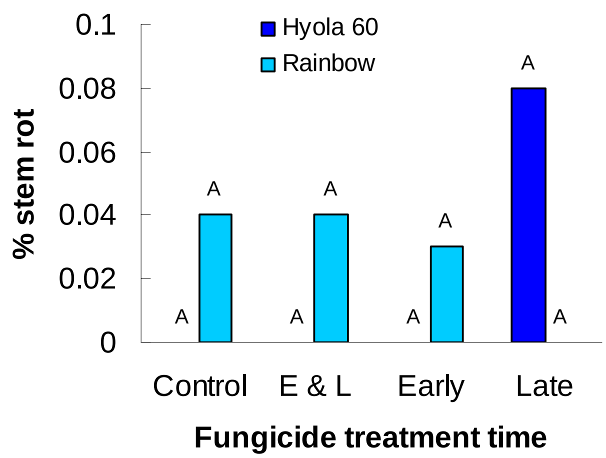


Figure 8. % Stem rot at Dirnaseer for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.1121.

Yield

At the Dirnaseer site Hyola 60 had a significantly higher yield than Rainbow (data not presented). The low incidence of stem rot resulted in no significant yield difference between fungicide treatments (Figure 9).

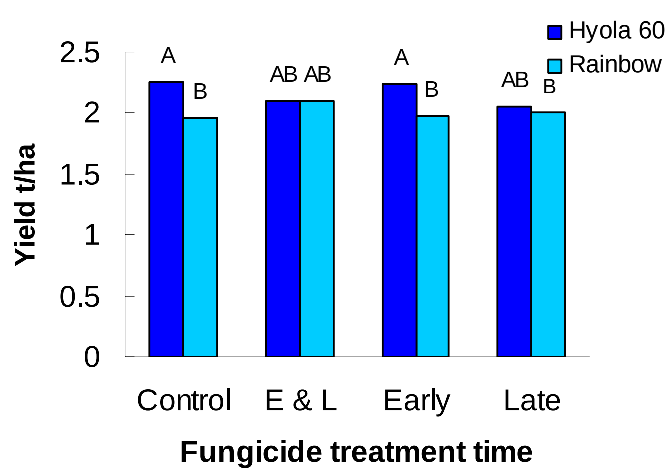


Figure 9. Yield at Dirnaseer for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD= 0.2014.

Wallendbeen – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Wallendbeen site was extremely low, with a maximum of 0.18% (Figure 10). For Rainbow the early & late fungicide application significantly reduced the amount of stem rot. Stem rot in Hyola 60 was not reduced with any fungicide application.

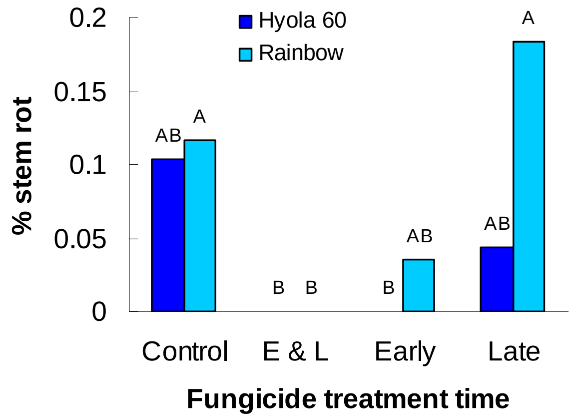


Figure 10. Percent stem rot at Wallendbeen for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.3105. Note: the LSD is taken from the square root of % stem rot data, data presented above is not square root data.

Yield

Hyola 60 had a significantly higher yield than Rainbow at the Wallendbeen site (data not presented). The low incidence of stem rot resulted in no significant yield difference between the fungicide treatments (Figure 11).

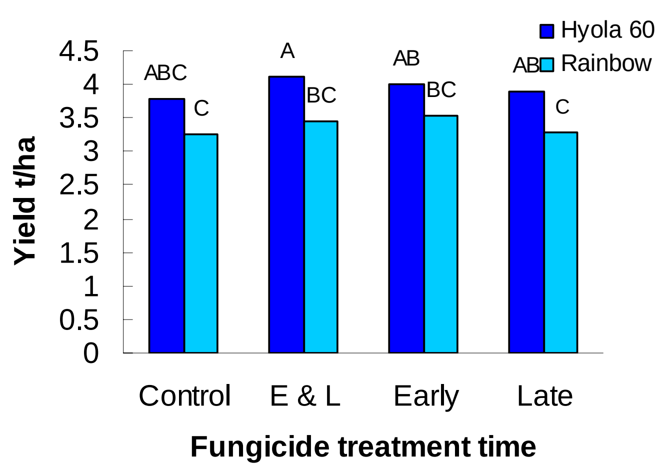


Figure 11. Yield at Wallendbeen for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.5686.

Wombat – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Wombat site was extremely low, with a maximum of 0.48% (Figure 12). The early application of fungicide in Hyola 60 had significantly less percent stem rot than the control. Stem rot in Rainbow was not reduced by any fungicide application.

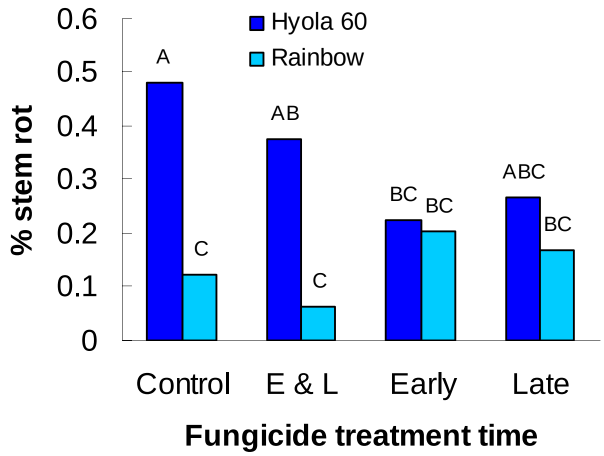


Figure 12. Percent stem rot at Wombat for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.2440.

Yield

Hyola 60 had a significantly higher yield than Rainbow at the Wombat site (data not presented). The low incidence of stem rot resulted in no significant yield difference between the fungicide treatments (Figure 13).

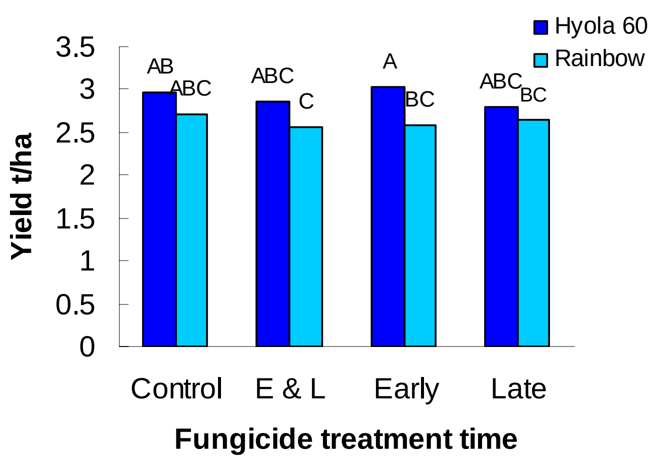


Figure 13. Yield at Wombat for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.3954.

Thuddungra – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Thuddungra site was extremely low, with a maximum of 0.62% (Figure 14). The percent of stem rot for Rainbow and Hyola 60 was not significantly reduced by any fungicide application.

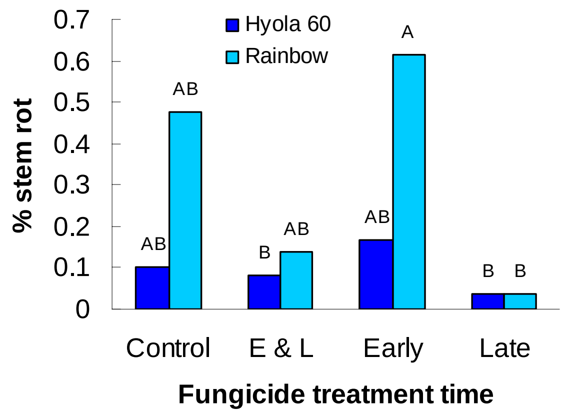


Figure 14. Percent stem rot at Thuddungra for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.4752. Note: LSD is taken from the square root of % stem rot data, data presented above is not square root data.

Yield

Hyola 60 had a significantly higher yield than Rainbow at the Thuddungra site (data not presented). The low incidence of stem rot resulted in no significant yield difference between the fungicide treatments (Figure 15).

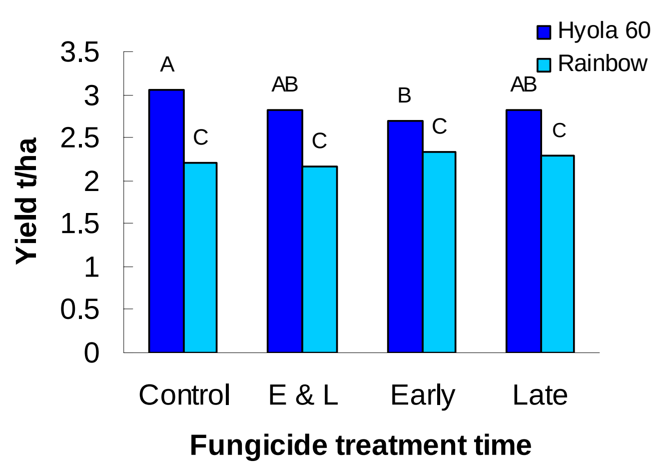


Figure 15. Yield at Thuddungra for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.2945.

Greenethorpe – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Greenethorpe site was extremely low, with a maximum of 0.32% (Figure 16). The early and the early & late fungicide applications in Rainbow significantly reduced percent stem rot. Stem rot in Hyola 60 was not reduced by any fungicide application.

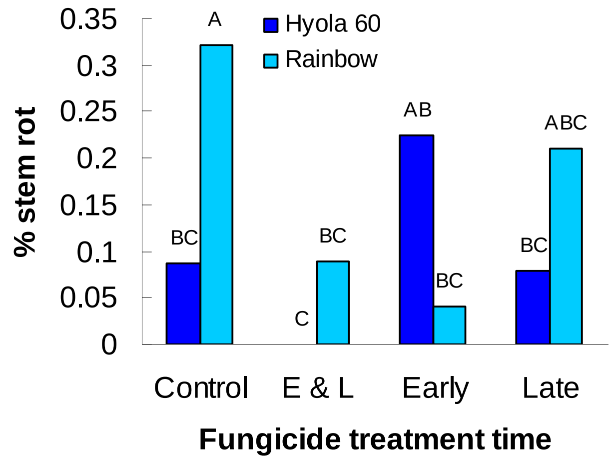


Figure 16. Percent stem rot at Greenethorpe for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.2235.

Yield

At the.Greenethorpe site the low incidence of stem rot resulted in no significant yield difference between the fungicide treatments in Rainbow and Hyola 60 (Figure 17).

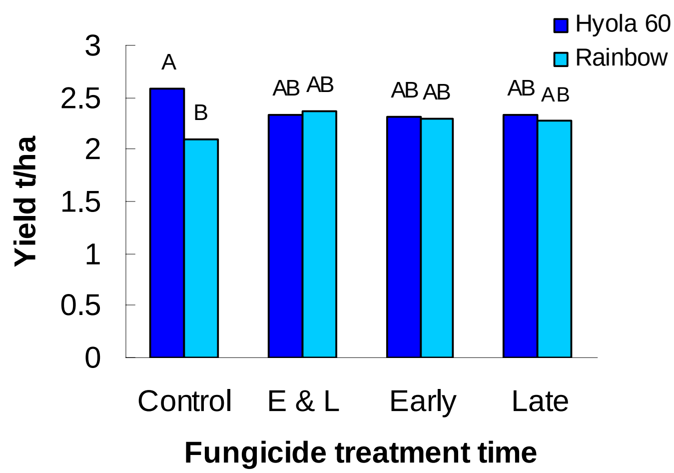


Figure 17. Yield at Greenethorpe for Hyola 60 and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.3375.

Tamworth – Stem rot incidence and yield results:

Stem rot incidence

Percent stem rot at the Tamworth site was extremely low, with a maximum of 1.04% (Figure 18). The early application of fungicide in Hyola 60 significantly reduced the percent of stem rot. Stem rot in Mustard and Rainbow was not reduced by any fungicide application.

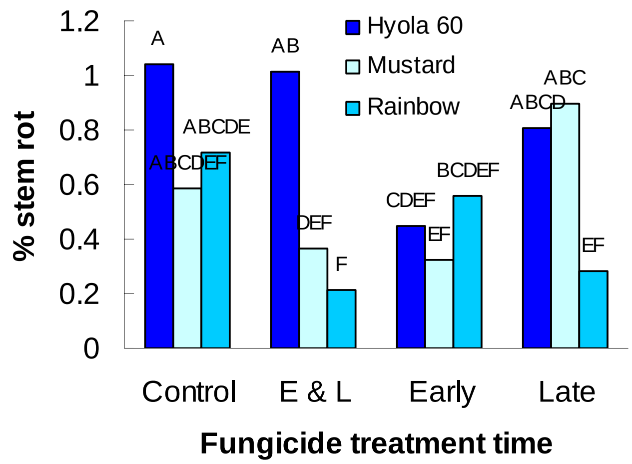


Figure 18. Percent stem rot at Tamworth for Hyola 60, Mustard and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.4528.

Yield

At the Tamworth site the low incidence of stem rot resulted in no significant yield difference between the fungicide treatments in Rainbow, Hyola 60 or Mustard (Figure 19). Mustard had a significantly higher yield than Rainbow or Hyola 60 (data not presented).

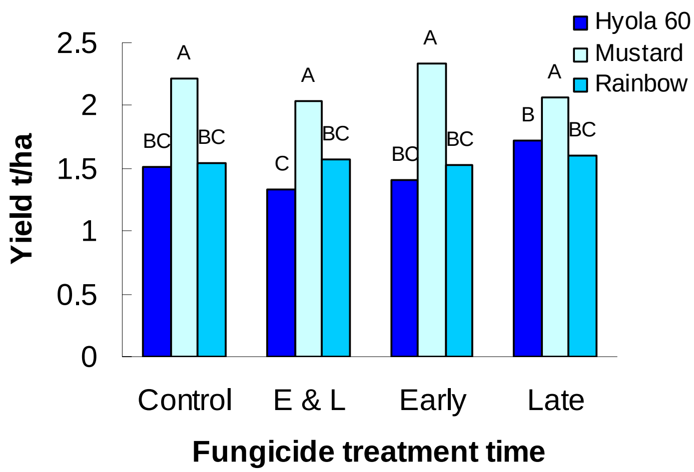


Figure 19. Yield at Tamworth for Hyola 60, Mustard and Rainbow treated with 2L/ha of Rovral liquid fungicide at 20-30% flowering (early), 2 weeks after 20-30% flowering (late) and at both 20-30% and 2 weeks later (E & L). LSD=0.3438.

The information contained in this publication is based on knowledge and understanding at the time of writing (April 2004). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.

RIVERINE PLAINS INC. RESEARCH AT WORK

Zonal Management in the Riverine Plains: An Introduction

Author: Brett Whelan **Contact No:** 02 9351 2947
Organization/Company: Australian Centre for Precision Agriculture (ACPA), University of Sydney, NSW
Author: Adam Inchbold **Contact No:** 03 5743 1749
Company/Company: Riverine Plains (project team*)

Key message:

- Variation in soil characteristics, soil moisture data and subsequent crop yield was considerable in the project paddocks.
- Further work is continuing to confirm the characteristics of zones within paddocks and the response of these zones to varying levels of inputs applied.
- The results of this project will help determine the economics of adopting Precision Agriculture (PA) techniques on a commercial scale.

Aim:

Riverine Plains Inc, along with other workers, have previously identified variation in important soil parameters within paddocks. Other workers in Australia, have developed a means by which this information can be brought together with yield maps and other spatial data to delineate management zones within paddocks. However, most farmers are yet to adopt this technique on a commercial scale.

Consequently, a project was designed to delineate and ground truth management zones in paddocks in the Riverine Plains and then investigate options to manage these zones more appropriately, according to their own unique characteristics. The eventual outcome would then provide advice on the best mix of Precision Agriculture (PA) tools for farms in the Riverine Plains, and develop a farmer friendly system approach to utilising PA in the Riverine Plains.

Method:

Paddocks at three sites across the Riverine Plains were selected as project paddocks. Broadly the sites are at Yarrawonga, Victoria (“Grand View” - Inchbold), Burrumbuttock, NSW (“Yaralla” - I’anson) and Urana, NSW (“Bogandillan” - Hamilton).

2003 was the first year of this project. In general terms, information that already existed on the project paddocks were combined with an updated EM 38 survey to delineate potential management zones within each paddock. Once these zones were arrived at, an extensive array of measurements were taken in each zone. This process is often termed “ground-truthing”, and is undertaken to determine if there are significant differences in important soil and plant parameters between zones. In 2003, ground-truthing undertaken in each zone included 0-10 cm comprehensive soil tests, 0-60 cm N tests (Deep Soil Nitrogen), data from in-crop monitoring, and soil moisture data using Gopher meters.

At ‘Yaralla’ yield maps which have been gathered for a number of years show consistent patterns of variability. In an effort to explain this variation, some information on the soil and landscape was gathered on the Freeling paddock using a mobile EM 38 and a highly accurate DGPS. Combining these maps together using a statistical clustering process allowed the paddock to be broken into 3 different production zones (Figure 20). These zones were then used to target soil sampling in an effort to characterise what was different about the soil in each zone.

Deep Soil Nitrogen (DSN) results were significantly different between zones, and there was sufficient interest to initiate a Nitrogen fertilizer response experiment. This involved the laying out of a replicated N rate trial in each zone to determine the response of each zone to varying rates of Nitrate nitrogen fertiliser (Figure 21). This methodology was also used at the other sites, and will also be used in the future to determine the response to other inputs in the delineated management zones. Yield maps and infrared images were and will be used to evaluate crop performance across the zones and also to determine the yield results of the test strips.

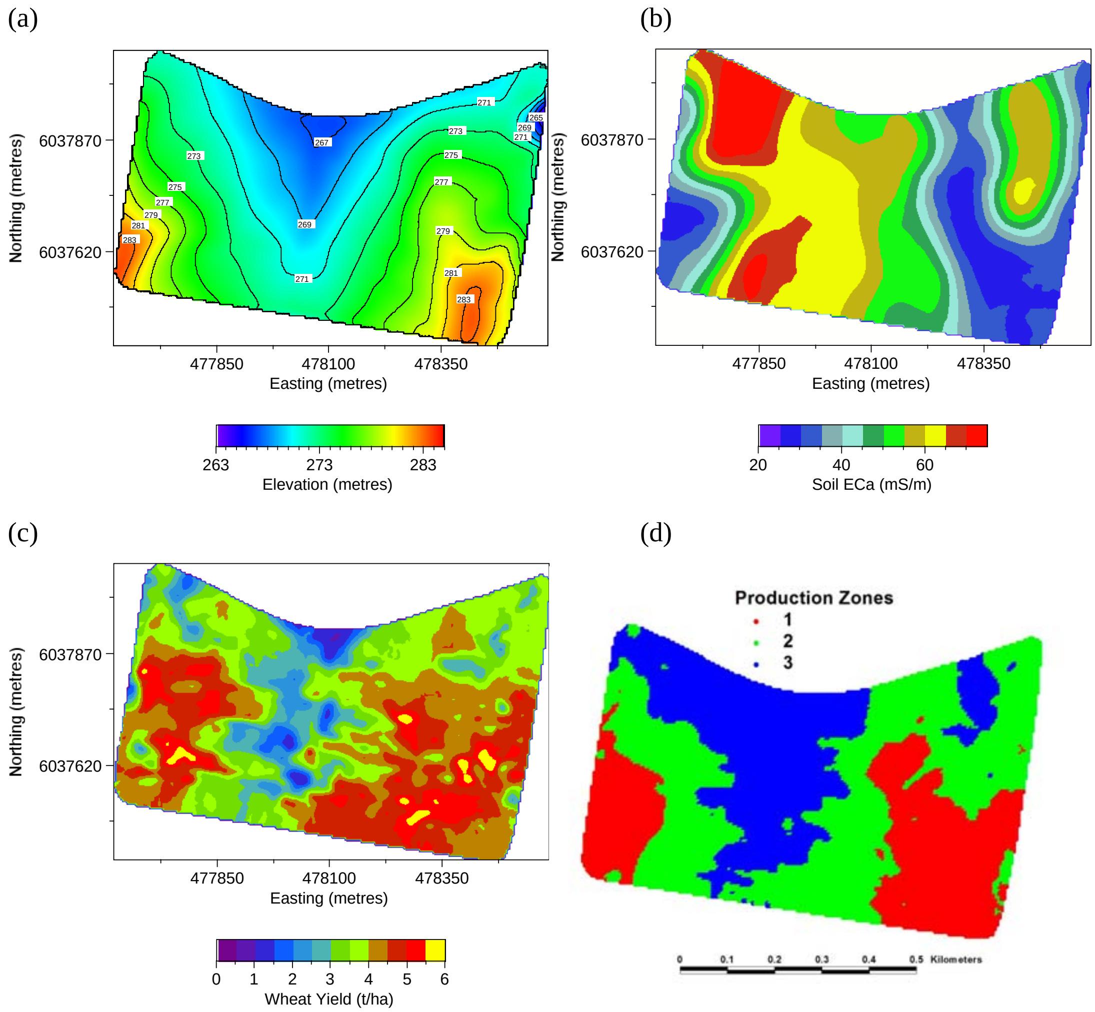


Figure 20. Freeling maps- (a) Elevation (b) Soil ECa from EM38 (c) Wheat Yield (d) Production zones.

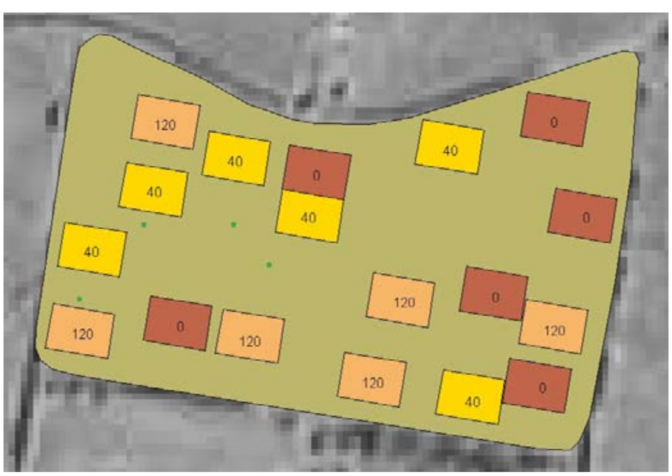


Figure 21. Freeling N fertilizer trial- laid out within the three production zones. The majority of the paddock received 80 kg urea/ha.

At ‘Grand View’, yield map data was more ambiguous due to a number of seasonal and agronomic issues. In paddock 44, it was decided to gather soil information using the EM 38 and use this as a starting point for breaking the paddock into zones. Targeted DSN sampling suggested that differences in yield could be expected and so a nitrogen response experiment was established in each zone (Figure 22 and Figure 23). Each zone was also monitored for changes in the soil moisture profile throughout the season.

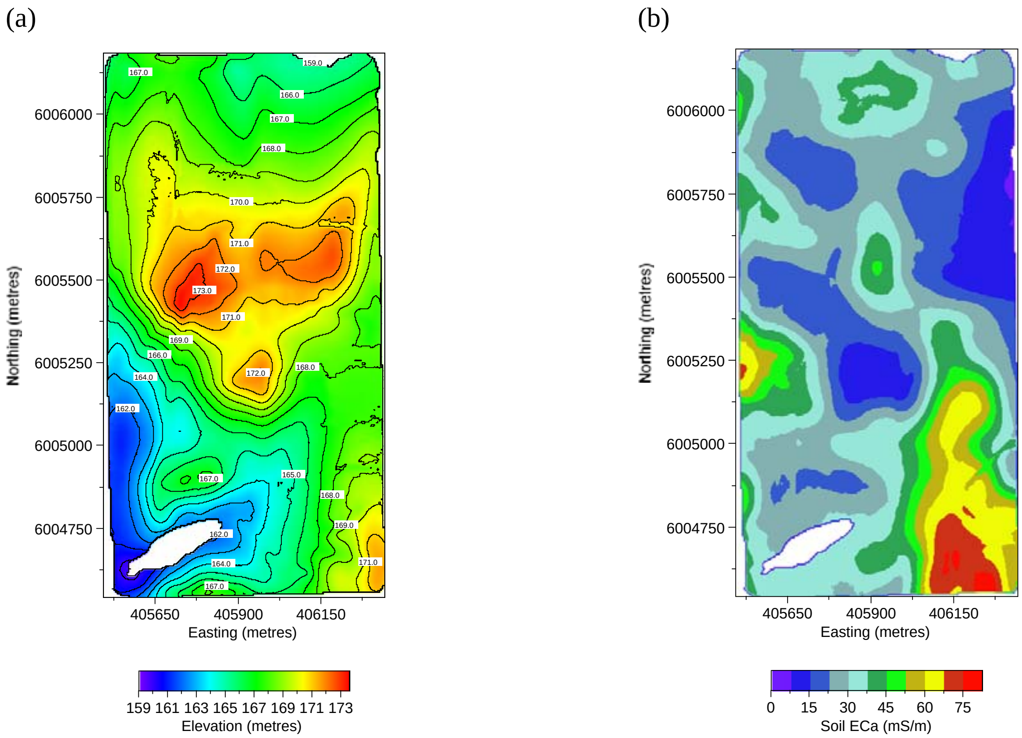


Figure 22. Paddock 44 maps – (a) Elevation (b) Soil ECa from EM38

(a) (b)

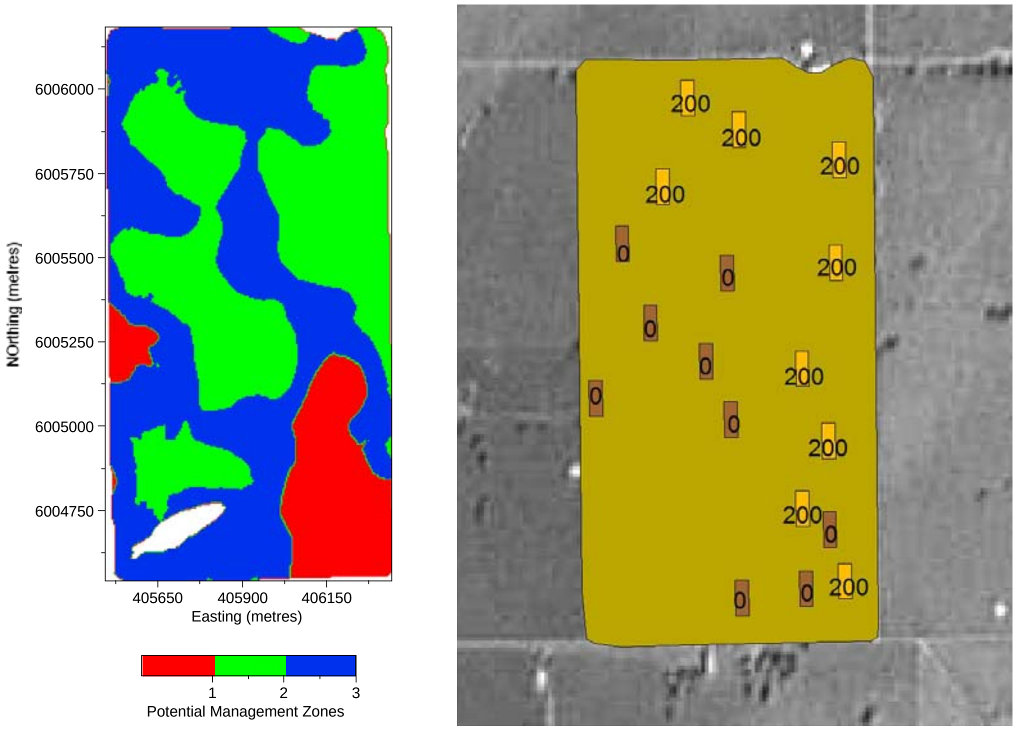


Figure 23. Paddock 44 maps – (a) Production zones (b) Urea fertilizer application map
The majority of the paddock received 100 kg Urea/ha.

Results:

The analysis of this year's data is ongoing; however, it is possible to make some general observations pertaining to the results that were gained last year.

Soil pits were dug in one of the paddocks at the Yarrawonga site, with one pit being dug in each of the three zones. Each soil pit was classified, and it was found that each pit was a distinctly different soil type. Under the Australian Soil Classification System (Isbell, 1996) the soil types are known as a Chromosol, a Sodosol and a Vertosol. More commonly these would have been described as a Red Brown earth, a Red Earth and a Grey Cracking Clay. A field day was held at this site with attendees being shown through each pit by a soil expert. The field day was well attended confirming the level of interest in the area. The differences between the soil pits broadly highlighted the potential for different management techniques to be employed in different zones within paddocks.

Soil and plant parameters that were taken did show variation between zones but more work needs to be done in this area before any decisive statements can be made. Moisture data that was taken at the Yarrawonga and Burrumbuttock sites using Gopher moisture meters has revealed considerable differences between zones. This data will continue to be gathered over the coming two years to consolidate that data set (a paper discussing this issue in more detail follows later in the chapter).

The DSN results did show considerable statistically significant differences between zones at all sites, confirming the potential for site-specific management of inputs such as nitrogen. This result was seen as encouraging and was the basis behind setting up N test strips in some paddocks (a paper addressing this issue in more detail follows later in the chapter). The results from these test strips will be accumulated over the life project and will eventually be an important part of the economic analysis of the potential for PA techniques in the Riverine Plains.

On both farms, the interim results show that the response to the fertilizer treatments is different between the defined production zones. This appears to tie in with the soil nutrient and moisture profile monitoring that has been occurring throughout the season. However, the impact of this in terms of how application rates may be changed for future management still needs to be assessed over a number of seasons. The project will continue to test fertilizer response with the same application plan this season. The results to date are very encouraging for the development of a PA system for integration into farm management in the Riverine Plains.

Observations and comments:

In general, variation in soil characteristics, soil moisture data and subsequent crop yield were considerable in the project paddocks. Further work is continuing to confirm the characteristics of zones within paddocks and the response of these zones to varying levels of inputs applied.

Farmers are encouraged to keep a careful eye on projects such as this one that will help determine the potential for the adoption of zonal management in commercial farming systems. Given continuing success, this project will develop a farmer friendly system for the adoption of PA techniques on commercial farms.

Riverine Plains will be extending results from this project to farmers through a series of discussion groups that will give farmers that chance to hear about results from this project, as well as discuss and learn about other PA related issues.

It is important to note that observations made here are only based on the first year of a three year project.

Sponsors: Riverine Plains Inc, GRDC, ACPA

***Riverine Plains "Zonal Management in the Riverine Plains" Project team**

Name	*Company*	*Contact*
Adam Inchbold	Riverine Plains/Farmer "Grand View"	03 5743 1749
Paul I'Anson	Riverine Plains/Farmer "Yaralla"	02 6029 3210
Brett Whelan	ACPA, University of Sydney	02 9351 2947
Peter Baines	Riv Plains/Tim Paramore Agronomic Services	0428 211 486
Tim Paramore	Riv Plains/Tim Paramore Agronomic Services	0428 686 370
John Sykes	Riverine Plains/John Sykes Rural Consulting	02 6023 1666
Lisa Cary Castleman	Riverine Plains/NSW Agriculture	02 6920 5177
Dale Grey	Riverine Plains/DPI Victoria	03 58 71 0600
Roy Hamilton	Farmer member "Bogandillan"	02 6035 230

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Zonal Management in the Riverine Plains: Soil-Water Monitoring Results

Author: Tim Paramore **Contact No:** 02 6021 1351

Organisation/Company: Tim Paramore Agronomic Services P/L, Albury NSW

Key message:

- There is considerable variation between light soils (low conductivity zone) and heavy soils (high conductivity zone) for water holding capacity.
- Potential yield must vary between soil zones as water is such a critical factor.
- Farmers can establish where soil zones are in their paddocks in order to optimise outputs and make best use of inputs.

Aim:

To investigate variations in water holding capacity in three different soil zones.

Method:

Soil moisture was measured at 10cm intervals down the soil profile with a moisture measurement sensor down to 1 metre. Readings were taken during the growing season twice weekly.

Soil moisture tubes were located within delineated management zones at "Yaralla", Burrumbuttock, and "Grand View", Yarrawonga. At each site, at least three moisture tubes were located in each management zone to provide some replication of results.

Results:

The soil moisture data gathered during 2003 is extensive due to the number of sites monitored. For the purposes of this paper a representative example from each management zone in paddock 44 (Yarrawonga) has been chosen to illustrate some important findings (see Figure 24, Figure 25 and Figure 26). The moisture profiles for these zones are expressed as summed histographs, which is the total moisture present in the profile to 1000mm when each reading was taken.

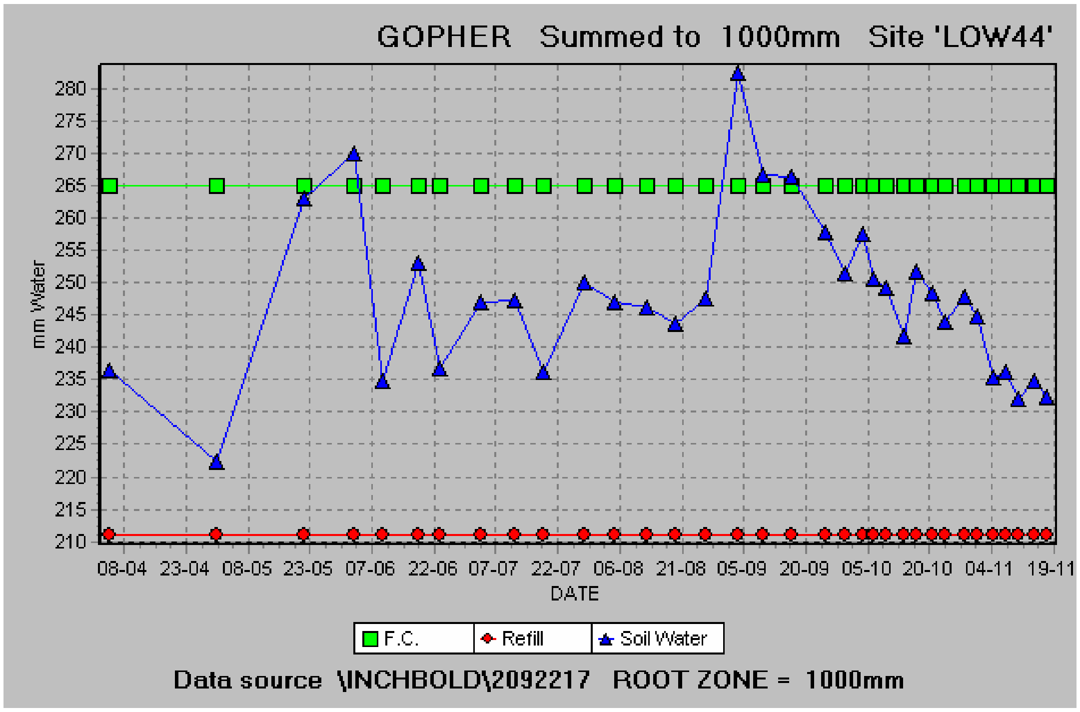


Figure 24. Soil moisture summed to 1000mm - low conductivity zone in #44

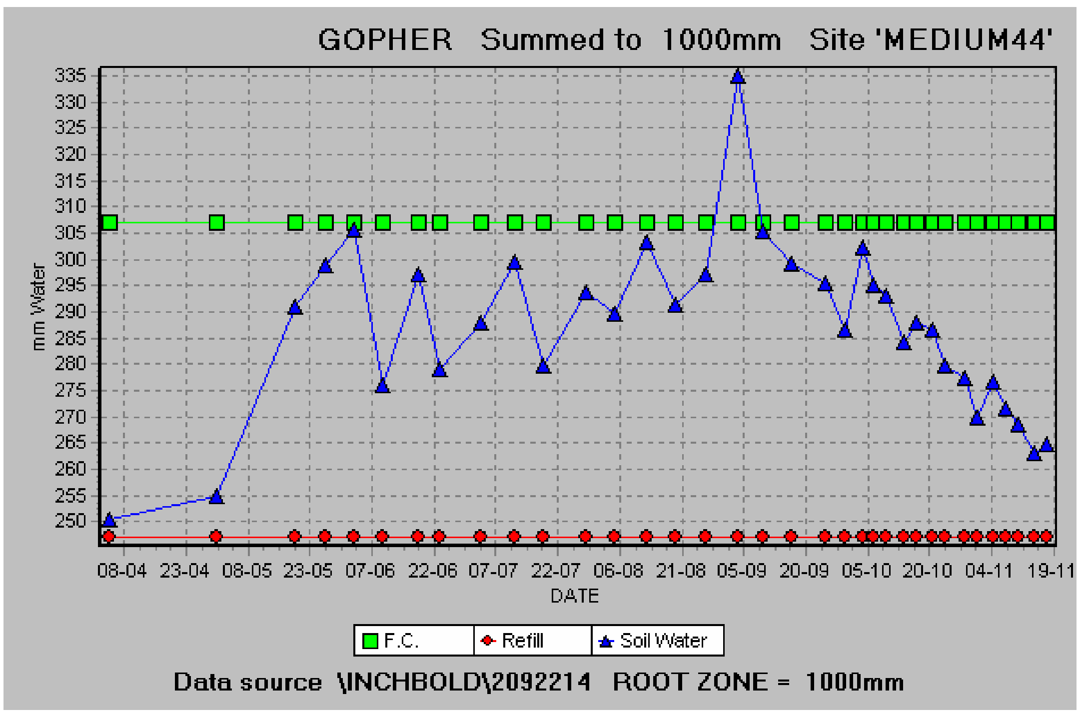


Figure 25. Soil moisture summed to 1000mm - medium conductivity zone in #44

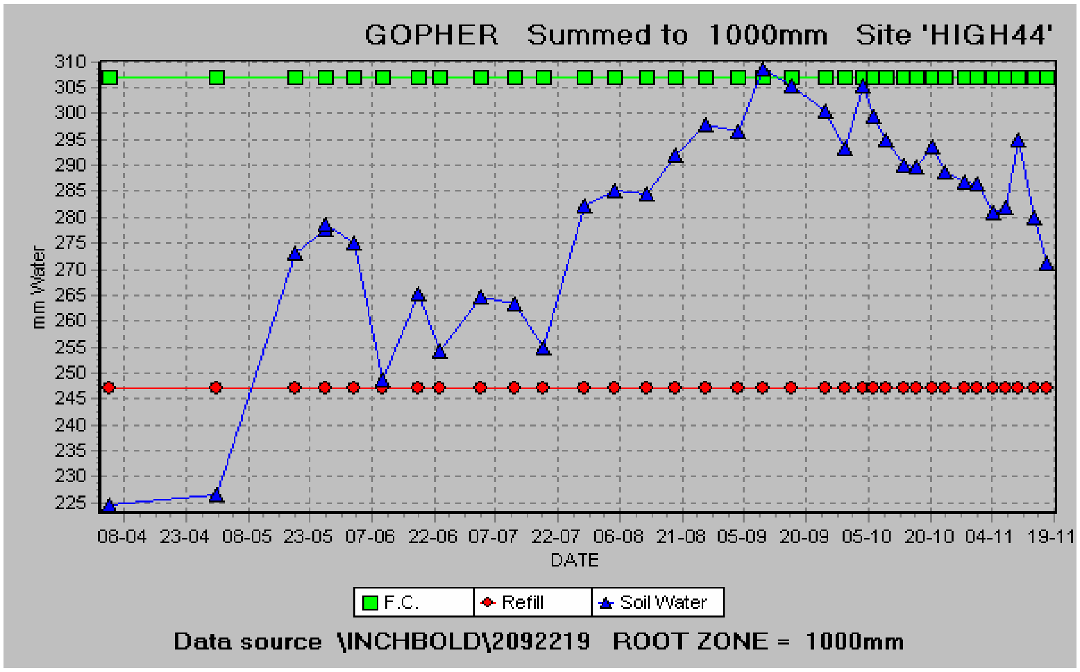


Figure 26. Soil moisture summed to 1000mm - high conductivity zone in #44

Observations and comments:

Definitions

Low conductivity zone – light soil type.

Medium conductivity zone – medium soil type

High conductivity zone – heavy soil type

Note: as has been discussed in the introductory paper soil type has been shown to vary significantly between management zones. In this paddock, zones have been delineated purely on the basis of an em survey. EM surveys measure apparent conductivity in the soil. Hence, it follows that lower conductivity reading may well represent soils of a lighter texture with less clay content, lower CEC. More detail regarding the differences between soil zones will follow as the project continues.

Field capacity – the total capacity of a soil type to hold water and have enough oxygen for roots to function.

Refill – point at which the plant has used up readily available water (RAW).

Findings

As can be seen from the above figures, there were considerable differences in the soil moisture profiles between zones.

The low conductivity zone was faster to wet up and dry out. Intuitively, therefore, it was the zone that had better drainage, but in a dry year, crop yield may have been limited by the relatively free drainage from this area. Compared to the low conductivity zone, the medium conductivity zone was slower to wet up and dry out, but the high zone was slower again to wet up and dry out. Given this was the case, some waterlogging was observed in the high conductivity zone.

In terms of overall water holding capacity, there were also some considerable differences between zones. Specifically, the water holding capacity of the low zone soil was far less than the other two, which were similar. This can be seen through the field capacity values that were determined for each zone, with the field capacity for the low conductivity zone being 260 mm compared to 305 mm for the medium and high conductivity zones. This also has important implications for potential yield in the paddock. While the low conductivity zone may be less prone to waterlogging in a wet year, the medium and high conductivity zones may have a much better capacity to yield in other years due to their ability to store moisture.

From April to November there were 325 mm of significant rainfall events. Two major events were 68mm in May and 61mm in August. The latter caused water logging in all zones. This was more significant in the better draining soils showing the greater amount of leakage.

Sponsors:

Thank you to Riverine Plains, GRDC and ACPA for their support.

Zonal Management in the Riverine Plains:
Variation in Deep Soil Nitrogen (DSN) Levels

Author: Peter Baines **Contact No:** 0428 211 486

Organisation/Company: Tim Paramore Agronomic Services P/L, Albury, NSW

Key message:

- Lighter textured soils (low EM zone) had an average of 18 kg more nitrogen (N) /ha or 0.5t/ha potential more grain yield than the medium (medium EM zone) and heavy soils (high EM zone).
- The average range of N within a paddock (common soil type/zone) was 50 kg N/ha or 1.3t/ha of potential grain yield.
- Deep soil nitrogen (DSN) sites were successfully selected (consistent DSN results to soil types) using electromagnetic surveying and yield mapping data.

Aim:

To identify the deep soil nitrogen status of management zones on 10 precision farming paddocks.

Method:

Three sample sites were selected in each zone based on electromagnetic (EM) 38 vertical survey and yield mapping data (delineation of management zones discussed in the previous paper). Within 5 metres of each sample site three 0-60cm cores were collected using a hydraulic ram soil sampler and a solid 48mm soil corer. A sub sample of the three cores was then sent to CSBP soils laboratory in W.A. for analysis of nitrate (NO_3) and ammonium (NH_4). Calculation of available N per hectare was then made by multiplying the laboratory result by 6 (depth of sample) and by 1.3 as the estimated bulk density.

Results:

The amount of available N from 90 sample sites ranged from 31 to 320 kg N/ha. Statistics (analysis of variance) indicate that significant difference occurred between the zones, with no significant difference in values occurring between replications ($P < 0.05$). This indicates that DSN values were consistent within each zone, and therefore a difference in DSN status between zones was meaningful. Average DSN results indicate that the high and medium conductivity zone each had 114 kg N/ha compared to 132 kg N/ha for the low conductivity zone.

Further statistical analysis (least significant difference P<0.05, 17.8kg N/ha) showed that the average difference in DSN within paddocks (between the zones) was 50kg N/ha with a range of 11 to 111 kg N/ha.

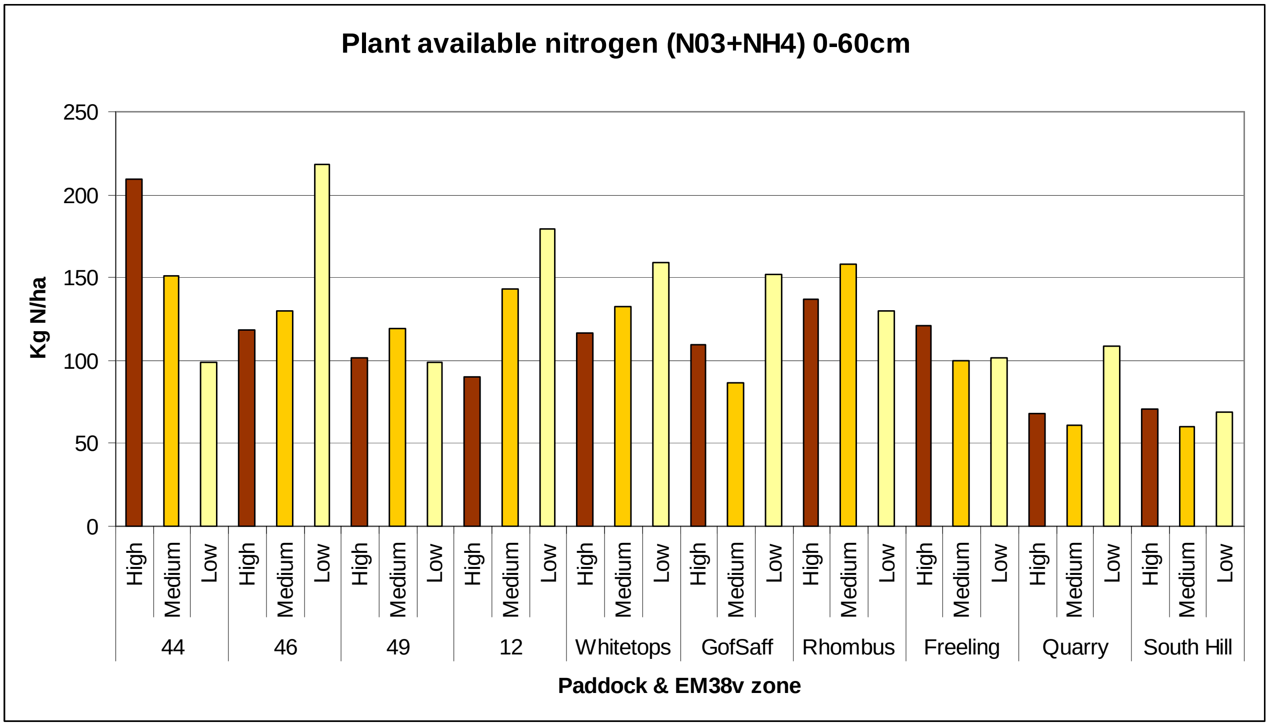


Figure 27. Total Plant Available Nitrogen

Observations and comments:

These results indicate the importance of collecting Deep Soil Nitrogen (DSN) samples to soil types and the opportunity to better match Nitrogen inputs to soil status. These DSN results show significant variation between paddocks and zones but not within a zone (assume a common soil type, pending soil classification within and between zones).

The results support the identification of the zones by conducting an electromagnetic survey and yield mapping. Doing individual soil tests such as DSN within (defined) zones will provide more consistent results.

Although the low (EM) zone did have the highest average DSN value, individual paddock variation is a significant observation and no single zone has a dominant amount of available N. This suggests that it was necessary to identify all three zones in order to generate accurate DSN results for precision farming.

The range of Deep Soil Nitrogen values highlights a clear opportunity for Precision Farming to better target nitrogen to match soil status and yield potential.

Sponsors:
Thank you to Riverine Plains Inc, GRDC and ACPA for their support.

The Effect of Controlled Traffic Farming on Soil Parameters

Author: Matt Cain (Ken Young - Supervisor) **Contact No. :** 03 5833 9200

Organisation/Company: University of Melbourne

Key message:

- Duplex red soils show more compaction than black soils.
- Reducing traffic reduced compaction similarly on both red and black soils.
- Decreasing levels of tillage increased the rooting depth of canola.

Aim:

To compare compaction due to tillage on black cracking clay soils and red duplex clay loam soils of the Riverine Plains.

Method:

A paddock with two soil types present and farmed under a controlled traffic system was selected and then sampled at five locations, (1) the permanent tramline, (2) next to the permanent tramline, (3) the intermediate tramline, (4) next to the intermediate tramline and (5) between the tramlines (Figure 1). The intermediate tramline had only the sowing operations. Ten samples were taken from each soil type and each sampling position for each variable was measured; soil bulk density, soil penetrometer resistance, soil moisture and canola root length.

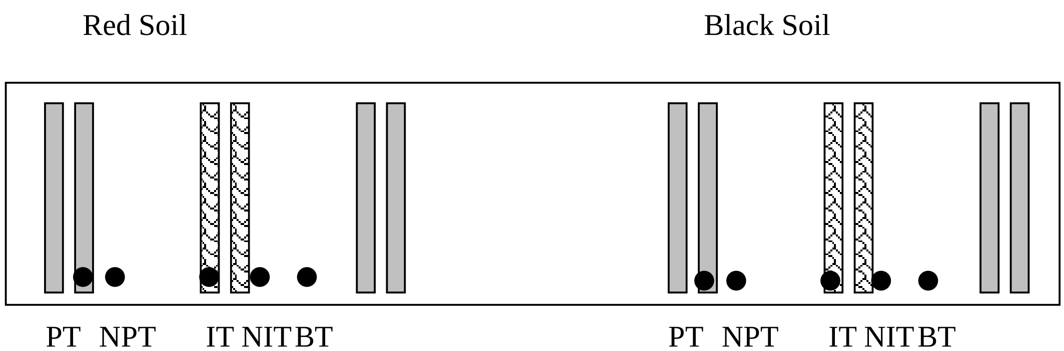


Figure 28. Controlled Traffic system shows permanent tramline (PT - solid lines) and intermediate tramline (IT - wavy lines).

The black circles represent the five sampling positions - PT - in the permanent tramline, NPT - next to the permanent tramline, IT - in the intermediate tramline, NIT - next to the intermediate tramline and BT- between the tramline.

Results:

The red loam soil had significantly higher bulk density, penetrometer resistance and shorter root length than the corresponding position in the black soil. The only exception was in the intermediate tramline with penetrometer resistance.

Within each soil type, differences between positions showed that bulk density was greater at both in the permanent tramline and next to the permanent tramline and there were differences between the other positions for both red and black soil.

For penetrometer resistance, there were significant differences between all positions in the red soil and for all except between "next to the permanent tramline" and "the intermediate tramline" positions. This was confirmed with root growth being significantly different between each position with the greatest root length occurring in between the tramlines in both soil types.

Table 33. Length of Canola Roots versus Penetrometer Resistance in the Soil

	Bulk Density (g/cm^3)		**Penetrometer Resistance (kPa)**		**Canola Root length (mm)**	
	RED	BLACK	RED	BLACK	RED	BLACK
Permanent Tramline	1.70	1.43	na	na	na	na
Next to permanent tramline	1.59	1.17	885	556	107.5	123
Intermediate tramline	1.48	1.07	535	493	121.5	149.8
Next to intermediate tramline	1.48	1.07	433	345	117.5	142
Between tramlines	1.46	1.06	314	226	132	161.3

Observations and comments:

The differences between red and the black soil types indicate that fewer benefits will occur from controlled traffic on red duplex soils than the black mulching soils. However, the general percentage increase in rooting depth was similar in the red and black soils being between 10% - 20%.

Investigations into the Incidence and Cause of Crop Diseases on the Riverine Plains

Author: Frank Henry, Project Officer **Contact No:** 0419 156 128

Organisation/Company: Joint Centre for Crop Improvement

Key message:

- Many plant diseases were widespread across the Riverine Plains.
- Current management practices may be contributing to the high incidence of disease.

Summary:

A survey of diseases in wheat and canola crops was undertaken in the spring of 2003. Results from the survey indicate that diseases are widespread on the Riverine Plains. The percentage of wheat crops infected with take-all was 16.0%, *Rhizoctonia* root rot 4.0%, yellow leaf spot 100.0%, barley yellow dwarf virus 100.0%, stripe rust 56.0%, eyespot 8.0% and *Septoria spp.* 4.0%. In canola, blackleg was detected in 100% of crops and *Sclerotinia* was detected in 88% crops. *Pratylenchus* nematodes were also prevalent in wheat and canola crops, but paddock symptoms are not obvious. The within crop incidence of *Pratylenchus* nematodes was 72% in wheat and 30% in canola.

It is probable that current management practices that include continuous cropping with wheat and canola are contributing to the high incidence of crop diseases observed during the survey. The next step is to investigate integrated management practices that can be used to reduce the impact of soil-borne and foliar diseases in cereals, and *Sclerotinia* in canola.

Introduction:

Farmers have observed a number of crop diseases on the Riverine Plains, but little localised information was available on the type and distribution of diseases in this region. Therefore, a survey of diseases in wheat and canola crops was undertaken in the spring of 2003. The aims of the survey were to identify the cause of disease problems on the Riverine Plains, and formulate integrated management strategies to control diseases. It is expected that the results of the survey will lay the foundation for further research into disease problems by students at the Dookie campus of the University of Melbourne.

Methods:

Twenty-five wheat crops and 25 canola crops grown on the Riverine Plains were sampled for disease during the spring of 2003. Each paddock was given an overall visual rating for disease symptoms, and plant samples were collected from each of 20 locations along a 100 metre zigzag transect in each crop.

In the laboratory, the roots of sample plants were washed free of soil, floated in a tray of water and assessed against a white background. Plant roots and foliage were then rated for disease damage by recording disease incidence and disease severity. Disease severity was based on a 0-5 scale (0 = No disease, 5 = maximum disease). Disease incidence was recorded as the percentage of affected plants in each paddock sampled. This rating system was also used for canola diseases; however *Sclerotinia* assessments were based on stem infections and the presence of sclerotes. The visual diagnosis of disease symptoms was confirmed by culturing pathogens from infected tissue.

There are two species of *Pratylenchus* nematode common in cropping soils: *P. thornei and P. neglectus*. Soil samples were collected from each paddock for *Pratylenchus* nematode assessment and identification. Dr Grant Holloway, DPI Horsham performed the nematode counting and species identification. As the soil samples are still being processed the results presented below are based on the visual assessment of plant roots.

Results:

The survey results are presented below. In Table 34, the results include the number of crops with disease and the disease assessments (incidence and severity) from within each crop. In Table 35, the results are presented on a regional basis. Region 1 is the Dookie area, Region 2 is the Corowa area and Region 3 is the Henty/Lockhart area. Table 36 is a summary of management practices used on the Riverine Plains. In both wheat and canola, the results from the survey indicate a high incidence of both soil borne and foliar diseases during 2003 (Table 34).

Table 34. Incidence and Severity of Wheat and Canola Diseases detected in Riverine Plains Crops in the Spring of 2003.

Wheat disease	Field disease rating (% of crops with disease)	Disease assessment (within crops assessment)	
	%	Inc %*	Sev (0-5)**
Cereal root diseases			
Pratylenchus nematode	na	71.8	1.0
Rhizoctonia root rot	4.0	57.8	0.9
Take-all	16.0	15.4	0.5
Crown rot	na	7.8	0.1
Cereal cyst nematode	na	1.0	0.1
Cereal leaf, stem and head diseases			
Yellow leaf spot	100.0	80.4	1.0
Ring spot	na	10.4	0.1
Stripe rust	56.0	10.2	0.2
Eye spot	8.0	7.6	0.3
Barley yellow dwarf virus	100.0	5.2	0.1
Loose smut	1.0	5.0	0.5
Spot blotch	na	4.4	0.1
Septoria	4.0	2.8	0.1
Canola root and stem disease			
Blackleg	100.0	86.6	1.0
Rhizoctonia root rot	na	35.8	0.4
Pratylenchus nematode	na	29.6	0.3
Sclerotinia	88.0	5.8	0.2

*Inc = incidence, the percentage of plants and or crops infected with disease

**Sev = severity, a disease rating based on a 0-5 scale where 0 =no disease & 5 = maximum disease

na = not available

There were differences in disease incidence between the different regions surveyed (Table 35). While the cereal root diseases, take-all, *Rhizoctonia* root rot and *Pratylenchus* nematode were distributed across all regions; neither cereal cyst nematode nor crown rot were detected in Region 3.

A high incidence of Yellow (leaf) Spot was found in all regions, while Stripe Rust, Barley Yellow Dwarf Virus, *Septoria*, Ring Spot and Spot Blotch predominated in Regions 2 & 3. Eye Spot was only detected in Region 1.

In canola, blackleg, *Sclerotinia*, *Rhizoctonia* root rot and *Pratylenchus* nematodes were detected in all regions surveyed.

Table 35. Incidence of wheat and canola diseases detected in Riverine Plains crops by region, spring of 2003

Disease	Inc (%)* REG 1**	Inc (%) REG 2	Inc (%) REG 3	Inc (%) Average
Cereal root diseases				
Take-all	15.0	16.1	15.0	15.4
Rhizoctonia root rot	49.1	67.2	60.0	58.8
Pratylenchus nematode	77.3	75.6	53.0	68.6
Cereal cyst nematode	1.8	0.6	0.0	0.8
Crown rot	12.3	6.7	0.0	6.3
Cereal leaf, stem and head diseases				
Yellow leaf spot	86.4	73.9	79.0	79.8
Stripe rust	12.3	13.3	0.1	8.6
Barley yellow dwarf virus	10.0	2.2	0.1	4.1
Septoria	1.4	6.1	0.0	2.5
Eye spot	17.3	0.0	0.0	5.8
Ring spot	5.0	22.8	0.0	9.3
Spot blotch	0.0	5.0	13.0	6.0
Loose smut	0.0	1.0	0.0	0.1
Canola root and stem disease				
Blackleg	80.4	92.1	86.0	86.2
Sclerotinia	7.3	7.9	7.0	7.4
Rhizoctonia root rot	31.5	40.7	40.0	37.4
Pratylenchus nematode	33.1	23.6	29.0	28.5

*Inc = incidence, the percentage of plants and or crops infected with disease

**Region 1 is the Dookie area, Region 2 is the Corowa area and Region 3 is the Henty/Lockhart areas.

Management practices on the Riverine Plains are characterised by continuously cropping, tight rotations comprised mainly of wheat and canola, stubble burning and crops established by direct drilling (Table 36).

Dr Ken Young, senior lecturer Dookie campus of the University of Melbourne, and Karl Schilg, Dookie Honours student, are currently analysing the survey data for any interactions between agronomic practices and disease incidence. This information will be discussed with members, and then used to formulate integrated management strategies to reduce the impact of diseases.

Table 36. Summary of Management Practices used in Wheat and Canola on the Riverine Plains, Spring 2003

Crop	Percentage of paddocks			Rotation for last three years, by percentage*			
	Direct drilled	Stubble burnt	Cont. cropped				
				WWC	WCW	WCP	WCPl
Wheat	96	64	92	28	40	20	8
				CWW	CWC	CWP or CPP	CWPl
Canola	88	76	96	48	4	32	8

*W = cereals mainly wheat, but includes triticale and barley. C = canola. P = pasture including clover and lucerne. PI = pulse crop

Discussion:

High levels of disease were found in all areas of the Riverine Plains surveyed during 2003. There are a number of probable reasons for this high disease incidence: 1. The Riverine Plains is a highly productive region with good rainfall, and conditions favourable for high grain yields are also favourable for many diseases. 2. Seasonal conditions during 2003 were favourable for soil-borne and foliar disease, as witnessed by the strip rust epidemic. 3. Management practices that include tight rotations with continuous cropping are not providing adequate disease break for soil-borne disease. Current stubble management practices are not reducing the incidence of stubble-borne diseases like yellow leaf spot, crown rot, eyespot and *Septoria*.

Cereal root diseases

A high incidence (71.8%) of *Pratylenchus* nematode indicates that the nematodes are favoured by the current rotations. The results of nematode extraction, undertaken by DPI Horsham, will provide an accurate estimate of nematode levels in the soil, and the species of nematode/s that predominate in Riverine Plains soils.

The high incidence (57.8%) of *Rhizoctonia* root rot is probably related to the high number of farmer's who *direct drill, as direct drilling has been shown to increase the incidence and severity of* Rhizoctonia. Sowing systems are available that can be used to reduce the severity of *Rhizoctonia*.

While the incidence of take-all (15.4%) and crown rot (7.8%) appear low, both diseases can cause large grain yield losses. Improved grass weed control, the inclusion of break crops in rotations and stubble management can be used to reduce the impact of these diseases.

While there was a low incidence (1.0%) of cereal cyst nematode (CCN); CCN could become a problem in the future as most farmers have a liming and gypsum program. Improving soil structure could also provide a favourable environment for CCN.

Cereal leaf, stem and head diseases

While many stubbles were burnt in 2003, a high incidence of stubble-borne diseases was observed during 2003. The high incidence of yellow leaf spot and a moderate incidence of eyespot and *Septoria* indicate that these diseases are surviving on stubble. Barley yellow dwarf virus was also prominent during 2003, and it may be necessary to examine the efficacy of aphid control.

Most farmers were able to minimize grain yield losses due to stripe rust with resistant varieties or foliar fungicides, however more information is needed on adult plant resistance, and the efficacy of combining fungicides application with resistant varieties. Dr Gordon Murray's (NSW Agriculture) rust prediction model (Rustman 2) proved helpful to many farmers making spray decisions.

Canola diseases

In canola, blackleg was widespread, and resistance is the key to reducing the impact of this disease. *Sclerotinia* was observed in 88% of crops, and this disease appears to be an emerging problem, because sclerotes remain viable in the soil for a number of years, and *Sclerotinia* has a wide host range that includes pulses and cape weed.

Disease by Region

Dividing the Riverine Plains in to different regions for the survey proved useful, as different regions appear prone to certain diseases. For example, eyespot, crown rot and barley yellow dwarf virus seems to be problems in Region 1, and to a lesser extent in Region 2.

Conclusions:

These survey results indicate that management practices are contributing to the high levels of crop diseases on the Riverine Plains. Management practices are available that will reduce the impact of soil-borne cereal diseases, but more information is required to successfully manage foliar diseases in cereals, especially in regard to fungicide application and aphid control. *Sclerotinia* in canola is emerging as a serious problem for canola and some pulse crops.

Recommendations:

1. Develop management practices to control of *Sclerotinia* in canola.
2. Identify a pulse crop that could be included as a break crop in rotations.
3. Examine how management practices can be modified to reduce the incidence of foliar diseases in wheat and *Sclerotinia* in canola.
4. Investigate the feasibility of controlling aphids to reduce the incidence of barley yellow dwarf virus.
5. Continue the disease survey in 2004.

Collaborators:

Table 37. Table of Joint Project Collaborators

Collaborator	Title/Role	Organisation
Prof. Jim Kollmorgen	Project Leader	University of Melbourne
Mr. Frank Henry	Project Officer	University of Melbourne
Dr. Gordon Murray	Data analysis and pathogen identification	NSW Agriculture
Dr. Ken Young	Data analysis and consultation	University of Melbourne, Dookie
Dr. Grant Holloway	Pathogen identification	DPI–Horsham, Victoria
Mr. Frank O’Connor	Adviser to project	University of Melbourne, Dookie
Ms. Andrea Montgomery	Adviser to project	Land Management Coordinator
Mr. David Cook	Project consultant	Riverine Plains Inc

Special thanks to Karl Schilg, Honours student University of Melbourne, Dookie; Rowan Watkins, Advance Diploma student University of Melbourne, Dookie and Ben White, Advance Diploma student University of Melbourne, Dookie, for technical assistance during the survey.

Thanks also to Assoc. Professor Denis O’Brien, Principal of the Dookie campus, University of Melbourne for fully supporting this project, and the Dookie staff; Dr. Ken Young for getting behind the survey and contributing his expertise at farmer meetings and analyzing data. Thank you to Mr. Frank O’Connor for providing laboratory space and continued support, Ms. Andrea Montgomery for organizing farmer meetings, and producing great flyers, and to the Riverine Plains executive committee, and all farmers who welcomed us on to their properties.

FARMING SYSTEMS - IN IT FOR THE LONG HAUL

Increasing Profitability with Lucerne

Author: Tim Clune **Contact No:** 02 6030 4500

Organisation/Company: PIRVic, Rutherglen Centre (DPI Rutherglen)

Key messages:

- Incorporating lucerne in mixed farming enterprises increases business profitability.
- Lucerne provides greater flexibility for cropping and livestock options.
- Inclusion of lucerne enables increases in stocking rate.
- Incorporating lucerne without broader management change limits its impact.
- The relative benefit of lucerne will vary according to individual farming operations.

Aim:

To assess the profitability of replacing annual legumes in cropping rotations with lucerne.

Method:

Growers groups across northern Victoria were surveyed to identify knowledge gaps and attitudes that may act as barriers to incorporating lucerne in crop rotations. A lack of a robust economic analysis of the inclusion of lucerne into crop rotations was identified as a major barrier to its broader adoption.

Case studies involving farmer co-operators across northern Victoria were conducted to assess the profitability of changing from an annual legume-based rotation to a lucerne-based rotation. The data used in the analyses were collected from the farmer co-operators through at least two interviews. An initial interview was conducted to characterise the farming systems and collect data on the costs of production. A follow up interview was held to check that the data collected accurately represented the farmer's production system and costs.

Farmer co-operators were drawn from a wide range of cropping environments. Average annual rainfall ranged from 324 to 583 mm, with growing season rainfall ranging from 212 to 383 mm. Soil types on which lucerne was grown included red and white sand, sandy loams, heavy grey clays and red/grey and black alluvial soils. This report highlights the data from the North Central and North East Victorian case studies.

Results:

Five grower meetings were held at the start of the project in north central and north east Victoria to investigate grower attitudes to lucerne. A total of 75 growers attended the meetings and all had a strong interest in making lucerne work on their farms. On average they had 17% of their farm under lucerne, compared with district averages of 1% to 2% of the total area in lucerne. In many other aspects their farms were typical of the surrounding districts; the average area was 1005 ha and 46% of the farm was in crop.

The reasons for establishing lucerne were as varied as the cropping environments and included soil health issues, summer weed control issues, profitability concerns, feed availability issues and better management of waterlogging.

In each case study, replacing annual pasture with lucerne in cropping rotations increased the profitability of the business, as measured by discounted cashflow analysis (Table 38).

Table 38. Effect of incorporating lucerne on business profitability of the 8 case studies.[a] The change in profitability compares the lucerne-based system with the annual legume-based system.

Case Study	Annual based rotation	Lucerne based rotation	Livestock enterprise annual system	DSE/ha	Livestock enterprise lucerne system	DSE/ha	Change in profitability (%)
1	5 years annual, O,W	5 years lucerne, L,B,W,B	Self replacing merino flock	4	Merino ewes/prime lambs	8	79
2	4 years annual, O,W,B	5 years lucerne, W,B,O	Self replacing merino flock	6	Merinos joined to dorset rams	12	49
3	5 years annual, W,C,W,B,P	4 years lucerne, W,V,W,B,W,B	Merino ewes and wethers	3	Merino ewes/prime lambs	5	80
4	6 years annual W,B,P,W,B	6 years lucerne, C,W,B,O,O	Merino ewes wool, prime lambs and cattle for yearling calves	8	Merino ewes wool, prime lambs and cattle for yearling calves	12	60
5	4 years annual, W,L,W,T	4 years lucerne, W,C,W,L,W,T	1st cross ewes/prime lambs	6	1st cross ewes/prime lambs	8	34
6	4 years annual, W,W,C,W,B	6 years lucerne, W,W,C,W,B	Self replacing merino flock	9	Self replacing merino flock	13	1
7	4 years annual, C,W,T,C,W,T,C,T	6 years lucerne, W,C,W,L,V/O	Self replacing merino flock	6	Self replacing merino flock	12	34
8	4 years annual, C,W,T,C,W,T	6 years lucerne, W,W,C,W,W,T	Vealer Cattle, Prime lambs	7	Vealer Cattle, Prime lambs	12	136
			Average	6		10	59

[a] Profitability was estimated for the annual and lucerne based systems using discounted cashflow analysis. B = Barley, C = Canola, F = Fallow, L = Lupins, M = Medic pasture, O = Oats, P= Peas, T = Triticale, V =Vetch, W = Wheat.

The relative increase in profitability was influenced by a number of factors including crop and livestock enterprise and changes in management as a consequence of incorporating lucerne in the farming system. In cropping enterprises, lucerne generally had a positive effect on gross margins where its adoption coincided with a lengthening of and/or use of more diverse pastures. The major change associated with livestock enterprises was an increase in stocking rate of approximately 75%, compared with the annual legume rotation.

Assessment of the enterprise mixes according to their contribution to total farm income using gross margin analyses indicated that the increase in profitability was on average split evenly between the cropping and the livestock system. Across Victoria incorporating lucerne increased cropping and livestock gross margins by an average of 18% and 26%, respectively, in comparison with the annual system. In North Central and the North East gross margins increased on average by 11% for cropping and 18% for livestock enterprises (Table 39). However, the range of impact on enterprise gross margins varied markedly. Changes in cropping gross margins varied from –29% to +39% and the effect on livestock gross margins ranged from 4% to 66% (Table 39).

Table 39. Effect of incorporation of lucerne on cropping and livestock enterprises.

Case Study	Cropping GM ($/ha) annual system	Cropping GM ($/ha) lucerne system	Change in cropping GM	Livestock GM ($/DSE) annual system	Livestock GM ($/DSE) lucerne system	Change in livestock GM
1	$266	$190	-29%	$17	$28	66%
2	$304	$274	-10%	$22	$30	34%
3	$175	$214	23%	$18	$21	19%
4	$328	$395	20%	$19	$23	18%
5	$215	$241	12%	$19	$21	6%
6	$471	$564	20%	$29	$30	4%
7	$299	$327	9%	$29	$30	4%
8	$279	$387	39%	$20	$22	9%
Average	$292	$324	11%	$22	$26	18%

Cropping gross margins did not increase at all. In case studies one and two the cropping gross margins were less than those achieved under the annual legume-based system (Table 39). In case study one the average gross margin decreased, but as there were more crops grown in the rotation the net effect on cash flow was positive. That is, since there were more cropping events, the actual return was greater than for the annual legume-based rotation. The negative effect on the average gross margin in case study two is a very strong indicator that incorporation of lucerne, without making other changes, will be of little benefit in the cropping enterprise.

The marked impact of lucerne in the livestock enterprise is due to two factors. Firstly, the inclusion of lucerne has enabled growers to increase carrying capacities, on average, by 75%. The greater impact of lucerne was however, that it enabled livestock enterprises to produce more lambs for the meat trade. In case studies one, two and three (Table 38) this coincided with a shift away from wool production.

Conclusion

This project has provided robust economic data to assist growers to develop strategic plans to meet the economic and environmental demands of mixed farming systems. The adoption of lucerne provides greater flexibility in both the cropping and the livestock enterprises.

Sponsors:

This project (DAV 453) was funded by DPI and GRDC.

Finishing Lambs on Lucerne at Burraja

Authors: Jeff Hirth, Ken Wilson and Tim Enshaw **Contact No:** 02 6030 4500

Organisation/Company: DPI Rutherglen

Key message:

- Out-of-season prime lambs can be successfully finished on dryland lucerne in this environment, although their growth rates depend on late spring and summer rainfall.
- Lambs finished on lucerne alone (pure lucerne) outperformed lambs finished on a grazing rotation of lucerne followed by annual pasture.

Aim:

This report is a summary of a grazing experiment conducted on lucerne sown on a red Chromosol (Red Brown Earth) in 1998 at Burraja Lowesdale (average annual rainfall = 506 mm, average GSR = 324 mm) near Corowa NSW. Second-cross wether lambs, born in July or August, were weaned onto the lucerne in the late spring of 1999, 2000 and 2001.

Method:

The lambs grazed the 0.8 ha plots/0.27 ha subplots as follows.

1. Lambs (7 per plot) were moved onto fresh lucerne every 2½ weeks in a three-subplot rotation (**RT**), to represent the traditional grazing practice for lucerne.
2. Lambs (7 per plot) were moved onto fresh lucerne in a three-subplot rotation when lucerne dry matter (DM) had been grazed to a residual of 800 kg/ha (**RF**), to optimise lamb growth rates.
3. In a two-plot rotation, lambs (7-28 per plot) were moved onto annual pasture when lucerne DM had been grazed to a residual of 500 kg/ha (**FG/AP**), and returned when lucerne regrowth had reached 800 kg/ha. This represents a likely grazing rotation on cropping farms with large paddocks.

All treatments were replicated four times, no supplementary feed was supplied and lambs were weighed each time they were moved. When lucerne regrowth had ceased, all lambs were removed from the plots and slaughtered; carcass data were collected in 2000 and 2001.

Results:

Our target lamb growth rate was 250 g/day, with target carcass specifications of 22-24 kg and 2-3 fat scores. In 2000, only 29% of lamb carcasses achieved 22-24 kg (43% fat score 2-3), while 6% were <22 kg (67% fat score 2-3) and 65% were >24 kg (25% fat score 2-3), reflecting their heavier live-weights at weaning (Table 40). In contrast, lambs slaughtered in 2001 were younger (August born) and lighter at both weaning and slaughter, and 53% of carcasses were <22 kg (93% fat score 2-3), while 20% were 22-24 kg carcasses (100% fat score 2-3) and 27% were >24 kg carcasses (70% fat score 2-3).

Table 40. Lucerne and prime lamb performance over the 1999, 2000 and 2001 summers

Grazing Period (days on plots)	Rainfall[A] (mm)	Grazing Treatment	Lucerne Yield[B] (t DM/ha)	Live-weight (kg) Start	Live-weight (kg) Finish	Lamb Growth Rates (g/day)
5/11/99-22/2/00	145	RT	1.12	29.0	55.0	239
(109 days)		RF	1.07	29.1	54.4	233
6/11/00-13/3/01	221	RT	2.02	24.5	49.9	202
(127 days)		RF	1.95	24.5	49.8	197
		FG/AP	0.85	25.0	43.8	148
23/10/01-15/1/02	91	RT	1.00	25.9	44.4	220
(84 days)		RF	0.98	25.9	45.8	237
		FG/AP	0.97	26.4	44.1	211

[A] Rainfall total from 1st October until when lambs were removed.
[B] Mean dry matter available whenever lambs were moved onto fresh lucerne.

Observations and comments:

The data shows lambs that rotationally grazed lucerne (RT, RF) gained 197-239 g/day, with no differences between these two rotational grazing treatments. Lambs that rotationally grazed lucerne and annual pasture (FG/AP) gained 148-211 g/day and spent on average 21.4 and 18.4 days, respectively, on the lucerne and annual pasture. In 2000/01, these lambs gained on average 219 g/day on lucerne but lost 59 g/day on annual pasture, which presumably reflected differences in feed quality and possibly rumen function. Although the success of finishing out-of-season prime lambs on dryland lucerne in this environment depends on late spring and summer rainfall, these data show that lambs finished on lucerne alone outperformed those finished on lucerne-dry annual pasture rotations.

Sponsors:

DPI Grains Program, GRDC (DAV399) and the Kingston family for the field site.

Essential details:

Location: Burraja Lowesdale	**Sowing information:** Sowing date: 4/10/1998 Fertiliser: 200 kg/ha super/lime/Mo; 150 kg/ha super annually thereafter	**Paddock history:** 1998 – 2002: lucerne	**Soil:** Type: Red Chromosol pH: 5.2 $CaCl_2$ (0-10cm) P (Colwell) 43 mg/kg
Rainfall (1999-2001): Total: 451 mm GSR: 291 mm		**Plot size:** 0.8 ha	**Replicates :** 4

How did Lucerne Inter-Cropping fare in 2003?

Author: Rob Harris **Contact No. :** 02 6030 4500

Organisation/Company: DPI Rutherglen

Key messages:

- In an inter-cropping system where the lucerne competes directly with the crop, there is likely to be less moisture available at grain filling and the risk of "haying off" is increased.
- At North Boorhaman, the grain yield of cereals grown with lucerne was 24% less in 2003 than cereals grown alone.
- At Burraja the grain yield was not significantly affected in the 2003 season by sowing cereals into lucerne stands.
- Lucerne in the inter-crop stubble can provide longer lasting and better quality summer feed for livestock than the stubbles from stand-alone crops.

Lucerne inter-cropping involves sowing annual crops into established lucerne stands. Some farmers' inter-crop young lucerne stands (9-12 months of age), while others inter-crop older stands (2-15 years of age).

In 2003, lucerne inter-cropping experiments were sown at North Boorhaman in NE Victoria and Burraja in southern NSW. Both sites were established to investigate the effect of topdressed nitrogen on the productivity of annual grain crops grown with lucerne. The Burraja site also assessed the impact of in-crop chemical suppression of lucerne, on improving the annual crop's productivity.

Both sites received above-average growing season rainfall (April – October) in 2003, with North Boorhaman receiving 24% and Burraja 20% greater than the long-term average. Grain yields reached their potential (5.6 t/ha) at Burraja, while at North Boorhaman grain yield was 39 to 54% below potential, due to frost damage in early September and a Stripe Rust outbreak in October.

At North Boorhaman, the grain yield of cereals grown with lucerne was 24% less than cereals grown alone (Table 41). At Burraja the grain yield was not significantly affected by sowing cereals into lucerne stands. The significant yield penalty at North Boorhaman may have been due to greater late spring lucerne productivity of the winter dormant Pioneer 54Q53 compared with smaller yields from the winter-active Aquarius lucerne at Burraja. The lucerne in the inter-crop at Burraja produced 1.2t DM/ha by harvest compared with 1.9t DM/ha at North Boorhaman.

Table 41. Grain yield and contamination of cereals grown alone and with lucerne at North Boorhaman and Burraja

Site	Treatment	Grain yield (t/ha)	Grain yield penalty (%)	Grain contamination with lucerne pods and flowers (n^{o}/hectolitre)
North Boorhaman	Wheat	3.7		nm
	inter-crop	2.8	24	nm
	lsd (*P*=0.05)	0.8		
Burraja	cereal*	5.6		0
	inter-crop*	5.0	11	53#
	inter-crop + supp*	5.3	5	2
	lsd (*P*=0.05)	n.s		22

*Average of wheat and barley crops

n.s not significant, nm not measured

AWB wheat receival standards require less than 50 pods and flowers per hectolitre for milling grain.

Suppression of lucerne during crop growth (inter-crop + supp) was carried out at Burraja in late August, which had no significant effect on increasing grain yield, but had a greater impact on grain quality, with reduced lucerne pod and flower contamination of the grain sample (Table 41). This grain could then be sold for human consumption. In last year's drought, suppression had no effect on reducing grain contamination, because there was insufficient spring rainfall to allow the chemical to function. The appropriate chemical, application timing and rate depend on the type of annual crop, soil moisture and weather conditions. If performed incorrectly suppression can actually kill lucerne plants, and this is why some farmers are hesitant to carry out the practice, especially in young lucerne stands. Therefore, seek advice from an experienced chemical specialist when planning in-crop lucerne suppression.

At North Boorhaman and Burraja 128 kg/ha of urea (60 kg/ha of nitrogen) was topdressed at the completion of crop tillering. Grain production at Burraja was unaffected by the additional nitrogen (data not shown), while yields were increased by 0.5 t/ha at North Boorhaman.

Table 42. Grain Yield Responses to Nitrogen Fertiliser at North Boorhaman

	Grain yield (t/ha)	
	No N fertiliser	**N fertiliser**
wheat	3.5	4.0
inter-crop	2.5	3.0

The reason the nitrogen response in grain yield was not measured at Burraja may have been due to several factors. Firstly topdressing barley with nitrogen caused the crop to lodge. Secondly the wheat crop at Burraja was sown later than at North Boorhaman and the dry conditions and rapid increase in temperature, experienced in November may have abruptly finished grain filling. Thirdly, there may have been adequate soil nitrogen available to the wheat and barley at Burraja to achieve their potential grain yield. Responses to applied nitrogen are only likely where soil nitrogen supplies are less than the crop demand for nitrogen, which is determined by water supply.

One of the difficulties with topdressing inter-crops with nitrogen is attempting to match nitrogen supply with available moisture. In an inter-cropping system where the lucerne competes directly with the crop, there is likely to be less moisture available at grain filling and the risk of “haying off” is increased, compared with crops grown alone. At this stage more data is required before guidelines for topdressing nitrogen onto inter-crops can be developed.

While grain yield reductions are common from sowing annual crops into lucerne stands, the lucerne in the inter-crop stubble can provide longer lasting and better quality summer feed for livestock than the stubbles from stand-alone crops. Economic analyses are planned to assess whether the cost of grain yield reduction from inter-cropping can be offset through improved animal performance from high quality feed on offer potentially available in inter-cropped stubbles.

The Effect of Triazine Herbicides on Sclerotinia Spore Formation

Author: Kristin Sutton (Ken Young - Supervisor) **Contact No. :** 03 5833 9200

Organisation/Company: University of Melbourne / NSW Agriculture (Tamrika Hind-Lanoiselet)

Key message:

- Atrazine and simazine reduce sclerotinia spore formation under laboratory conditions.

Aim:

To determine the effects of herbicides atrazine and simazine on the spore formation of the fungal disease sclerotinia, considered by canola growers to be their second most important disease after Blackleg.

Farmers in New South Wales had observed that when atrazine or simazine had been applied to Triazine Tolerant Canola for weed control it had reduced the amount of *Sclerotinia* stem rot. There is circumstantial evidence suggesting that these herbicides cause abnormalities in apothecia formation. With the inability to produce spores the fungi is unable to reproduce and infect canola crops unless the spores have blown in from other sources such as neighbouring paddocks.

Method:

Sclerotes of Sclerotinia were put onto petri dishes filled with clean washed sand and incubated at 20°C. Atrazine or simazine was applied to sclerotia at 0, 250, 500, 1000, 2000 and 4000g a.i./ha (grams of active ingredient per hectare). Applications of atrazine and simazine were also applied at mixes of 500+500g a.i./ha, 1000+1000g a.i./ha and 1000+500g a.i./ha respectively.

Results:

Apothecia developed on the untreated control and the lower dose rates of atrazine and simazine. Once rates exceeded 250g a.i. atrazine/ha there was no normal apothecia formed. For simazine, 500g a.i. simazine/ha was required before no normal apothecia were formed. The combination of atrazine and simazine had no normal apothecia formation. Sporulation was mainly associated with untreated controls.

Table 43. The Effect of Atrazine and Simazine on the Formation of Apothecia and Spores in Cultured Sclerotinia

Herbicide Rate (g a.i./ha) A	S	No. of Apothecia formed		No. of Normal Apothecia		Total Spore No. / petri dish	
0	0	5.63	d	4.88	c	588889	b
250	0	4.63	bcd	0.00	a	0	a
500	0	2.38	ab	0.00	a	0	a
1000	0	3.13	abc	0.00	a	0	a
2000	0	3.38	abc	0.00	a	0	a
4000	0	1.88	a	0.00	a	0	a
0	0	5.25	cd	4.25	c	788742	b
0	250	5.63	d	2.25	b	198889	a
0	500	3.50	abcd	0.00	a	0	a
0	1000	2.38	ab	0.00	a	0	a
0	2000	2.88	abc	0.00	a	0	a
0	4000	2.88	abc	0.00	a	0	a
1000	1000	3.63	abcd	0.00	a	0	a
500	500	3.38	abcd	0.00	a	0	a
1000	500	2.25	a	0.00	a	0	a
LSD ($P<0.05$)		2.37		0.89		271550	

Note: Means followed by the same letter within a column are not significantly different at the 5% level using LSD's, A=Atrazine, S=Simazine.

Observations and comments:

While this experiment has shown a reduction in spore formation due to atrazine and simazine, the rates required to achieve a similar level in the paddock are likely to differ and field evaluation of the products is to be conducted in 2004.

Only one isolate type of sclerotinia was examined.

Revised Variety Response to Stripe Rust for Eastern Australian Wheats

Authors: Colin Wellings, Harbans Bariana and Robert Park **Contact:** 02 9351 8826

Organisations/company: Cereal Rust Lab, PBI Cobbity, University of Sydney

The anticipated response of wheat varieties to stripe rust pathotypes is clearly an important issue for growers making varietal choices in 2004. Preliminary information with some illustrations was circulated in December 2003 as part of the Cereal Rust Report series from PBI Cobbitty. This issue is current as at 31 March, 2004 and provides updated information for growers and advisors.

Background to the data:

Table 44 summarises a consensus of data following a teleconference between colleagues at Adelaide (Hugh Wallwork), Horsham (Grant Hollaway, Russell Eastwood, John Brown), Wagga Wagga (Peter Martin, Andrew Milgate), Orange (Frank McRae) and Cobbitty (Robert Park, Harbans Bariana and Colin Wellings). The meeting arose from discussions concerning preliminary data distributed by PBI Cobbitty on the assessments of several varieties, although the overall relative ranking order of varieties was generally agreeable. In an attempt to reconcile these issues, and that of ranking scales, Table 44 presents an agreed set of responses based on the following scale:

Rank (NSW/QLD)	Disease response	Description
1	VS	
2	S	susceptible
3	MS-S	
4	MS	moderately susceptible
5	MR-MS	
6	MR	moderately resistant
7	R-MR	
8	R	resistant
9	VR	

The first two columns of data indicate the responses expected to the respective pathotypes. The final column indicates a worse case scenario, based on either the highest response from the previous columns, or in the case of varieties with *Yr17*, the expected response to a pathotype with virulence for *Yr17*. In several instances, data is indicated in brackets. This signifies that the available data is scant, even anecdotal, and is yet to be verified. Entries marked "-" indicate no available data.

Table 44. Changes in Stripe Rust Resistance in Wheat Varieties

Variety	H45 Pathotype (code: 110 E143 A+)		WA Pathotype (code: 134 E16 A+)		Worst case scenario	
	Response	Ranking	Response	Ranking	Response	Ranking
Anlace	MR-MS	5	MS-S	3	MS-S	3
Annuello	MR	6	MS	4	MS	4
Babbler	R-MR	7	MS	4	MS	4
Baxter	R-MR	7	MS	4	MS	4
Bowerbird	MR	6	MS-S	3	MS-S	3
Bowie [1]	R-MR	7	R	8	MR-MS	5
Braewood	R-MR	7	R	8	R-MR	7
Brennan	R-MR	7	R	8	R-MR	7
Camm [1]	R	8	R	8	S	2
Chara	R-MR	7	MS	4	MS	4
Cunningham	R-MR	7	MR-MS	5	MR-MS	5
Currawong	R-MR	7	MR	6	MR	6
Diamondbird	R-MR	7	MS	4	MS	4
Declic	R	8	R	8	R	8
Dennis	R	8	-	-	-	-
Drysdale	MR	6	MR-MS	5	MR-MS	5
EGA Bellaroi	R	8	R	8	R	8
EGA Wedgetail	R-MR	7	MR	6	MR	6
Frame	MR-MS	5	MR-MS	5	MR-MS	5
GBA Combat	MR, MS-S	6,3	MR,MS-S	6,3	6,3	MR,MS-S
GBA Ruby	R	8	R	8	R	8
GBA Sapphire	MS	4	MS	4	MS	4
GBA Shenton	R	8	R	8	R	8
Giles	R-MR	7	MR-MS	5	MR-MS	5
Goldmark	MR	6	MR-MS	5	(MS)	(4)
Goroke	MR	6	(MR-MS)	(5)	(MR-MS)	(5)
H45	MS-S	3	VS	1	VS	1
Hybrid Mercury	R-MR	7	MS	4	MS	4
Janz	R-MR	7	MR-MS	5	MR-MS	5
Kellalac	MR	6	MR-MS	5	MR-MS	5
Kennedy	R-MR	7	MR-MS	5	MR-MS	5
Krichauff	MR-MS	5	S	2	S	2
Kukri	MR	6	MR	6	MR	6
Lang	R-MR	7	MR-MS	5	MR-MS	5
Leichardt	R-MR	7	MS	4	MS	4
Lorikeet	MR	6	MS	4	MS	4
Machete	MS	4	MS-S	3	MS-S	3
Mackellar	R-MR	7	R	8	R-MR	7
Marombi	R	8	R	8	MR-MS	5
Meering	MR	6	MS	4	MS	4
Mira	MR	6	MR	6	MR	6
Mitre	MR	6	MS-S	3	MS-S	3
Ouyen	MR	6	MR-MS	5	MR-MS	5
Pardalote	R-MR	7	MR-MS	5	MR-MS	5
Petrel	MR	6	MS	4	MS	4
Petrie	R-MR	7	MR-MS	5	MR-MS	5
Pugsley[1]	R,MS	8,4	R, MS	8,4	MS	4
QAL Bis[1]	R	8	R	8	MR-MS	5
Rosella	MR	6	MR-MS	5	MR-MS	5
Rudd [1]	R	8	R	8	-	-
Snipe	MR	6	MR-MS	5	MR-MS	5

Strzelecki	R-MR	7	R-MR	7	R-MR	7
Sunbri	R-MR	7	R	8	R-MR	7
Sunbrook	MR	6	MR-MS	5	MR-MS	5
Sunco	R-MR	7	MR-MS	5	MR-MS	5
Sunlin	R	8	R	8	MR-MS	5
Sunsoft 98	R-MR	7	R-MR	7	MR-MS	5
Sunstate	R	8	R	8	R	8
Sunvale	R	8	R	8	R	8
Silverstar	MR	6	MS-S	3	MS-S	3
Tamaroi	R	8	R	8	R	8
Tennant	R-MR	7	R-MR	7	R-MR	7
Thornbill	MR	6	MR-MS	5	MR-MS	5
Trident [1]	R	8	R	8	S	2
Warbler	R	8	-	-	-	-
Whistler	MR	6	MR-MS	5	MR-MS	5
Wollaroi	R	8	MR	6	MR	6
Wyalkatchem	S	2	MS-S	3	MS-S	3
Wylah	R-MR	7	MR-MS	5	MR-MS	5
Yallaroi	R	8	MR,MR-MS	6,5	MR-MS	5
Yitpi	MR	6	MR-MS	5	MR-MS	5

[1] Indicates varieties with *Yr17*. These wheats will be resistant to both pathotypes listed, but will show varying responses to pathotype 104 E137 A-, Yr17+ (see column 3).

Post-script

Recent data has come to hand from Robert Loughman and colleagues from Western Australia. The field site at Manjimup was inoculated and the disease level noted to be uniform. Comparisons between the WA data and that from the east show a very good correlation. The exceptions were Banks, Datatine and Wollaroi that were more diseased in the west, and Mitre and Wyalkatchem that were more resistant in the west. These differences may be due to several factors, including seed source and environment, and will require further confirmation.

Environmental Management Systems (EMS) – where are we up to now in the grains industry?

Author: E. Seymour[1], A. Ridley[1] & T. Paramore[2] **Contact No. :** 02 6030 4500

Organisation/Company: [1]Department of Primary Industries, Rutherglen Research Institute, RMB 1145, Rutherglen, Vic.

[2]Paramore Agronomic Services, Frauenfelder St, Albury, NSW.

Key messages:

- EMS is a structured approach to help farmers assess, document and improve their environmental performance.
- EMS can be a very useful tool to help farmers improve management for both production and environmental purposes.
- The trends for environmental accountability are continuing on the international and national scene. A number of EMS projects across industries are underway to prepare farmers for future market demands and ensure compatibility with Quality Assurance (QA) requirements.

Aim:

- To develop a national tiered approach to EMS for Australian grain growers with seamless links to QA, where the lower level starts with environmental awareness ranging through to the highest level of ISO14001 (the international standard).
- To align closely with other important national projects including the Commonwealth EMS pilot projects and the lamb industry EMS project (MLA) to ensure a practical system for mixed grains and livestock enterprises that considers both on-farm and catchment environmental outcomes.

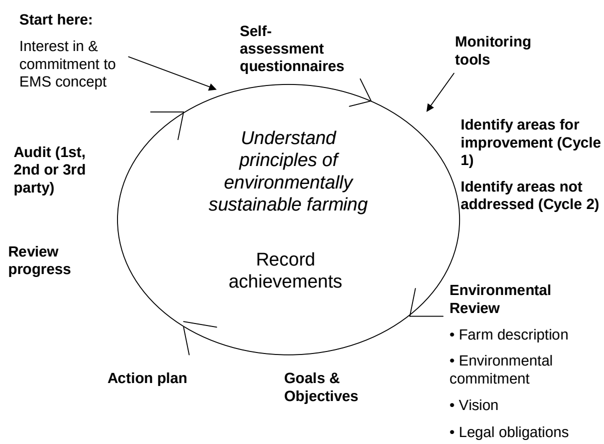
Method:

1. The findings of previous GRDC EMS projects (including the Riverina EMS) were used as a basis for the current stage of GRDC investment – 'Preparing for EMS in the Australian grains industry'. The findings included: a) the adoption of ISO14001 compliant EMS would be low given the absence of strong market drivers; b) training in environmental education and improved paddock record keeping is needed; c) group learning and the development of environmental monitoring tools can be a rewarding part of EMS for

farmers; and d) EMS can be useful to help farmers become better production and environmental managers.

2. A tiered approach to EMS is to be developed using the full EMS cycle as a basis (see Figure 29).
3. To reduce the incidence of fragmented approaches to EMS, the GRDC EMS project will align with several new EMS projects initiated at the local and national level.

Figure 29. The EMS Cycle



Results:

A tiered approach to EMS for grain growers

This project recognises that the majority of farmers are not yet ready for a full EMS. However, there is a need to ensure that farmers are 'EMS ready', particularly if there are market access issues in the future. Potential EMS stages have been developed and will be tested over the next 12 months. The first stage proposed is based on environmental awareness where farmers assess their own environmental performance. The second stage is called an 'Environmental Farm Plan' and includes self-assessment, action planning, farm monitoring and a self-audit. The top stages are ISO14001 compliant, with or without a third party audit.

Links to QA

The seamless linkage of EMS and QA is important to overcome issues of duplication in farm record keeping and auditing. The requirements of the major grain and livestock QA schemes will be considered in developing a framework for linking with EMS. QA auditors and farmers will be included in the process to ensure practicality.

Links to other EMS projects and where are we up to?

A lot has happened since the original GRDC EMS project concluded (2002). We have strong linkages with the following other EMS projects:

- As part of the National EMS program (Department of Agriculture, Fisheries & Forestry or DAFF), a major project is being conducted in three Victorian catchments to test EMS in nine farmer groups and explore how on-farm EMS links with catchment targets.
- The original GRDC Riverina group now lead another of the national pilot projects. They will continue to further develop EMS and also provide expertise to new groups forming in the Holbrook-Culcairn region and in the irrigation areas.
- The rice industry in southern NSW and the Gippsbeef group in Gippsland are both part of the national EMS pilot program.
- A not for profit company, the Australian Landcare Management System (ALMS Ltd.), has a further national pilot project being run in a complimentary fashion with the Victorian catchments work. Groups are being established in central Victoria and South Australia.
- The Victorian CMA and ALMS groups have produced the first version of the Australian EMS Manual and hope it will become the ISO14001 compliant on-farm EMS for Australia (with revisions from stakeholders such as GRDC and farmer users).
- A two year EMS lamb industry pilot (MLA) will develop EMS with two producer groups, one working with an export supply chain, the other supplying a domestic supply chain. EMS will be modified to suit the particular supply chain.

Observations and comments:

- The barriers to adoption of EMS will remain until there are financial incentives. Governments and Catchment Management Authorities are moving in this direction.
- Farmers are currently poorly prepared to demonstrate their ‘clean and green’ credentials.
- EMS is a powerful tool that allows farmers to demonstrate their ‘green’ credentials – thus retaining market access should EMS ever become a requirement.
- EMS offers both production and environmental benefits and is an important part of the farm business.

Sponsors:

- Grains Research & Development Corporation (GRDC)
- Department of Primary Industries, Victoria (DPI)
- Department of Agriculture, Fisheries & Forestry (DAFF)