Acknowledgements

Compiling the 2005 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 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 contributing authors, thank you for your time and efforts in bringing your results to Riverine Plains Inc. Riverine Plains Inc recognise that the input of staff from DPI Victoria and DPI NSW, contributors from the Universities of Sydney and Melbourne, agribusiness and enthusiastic colleagues at FarmLink is essential in delivering this publication. Your support is greatly appreciated.

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. Your input is essential for the continued success of Riverine Plains Inc.

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.

Tim Clune
Editor

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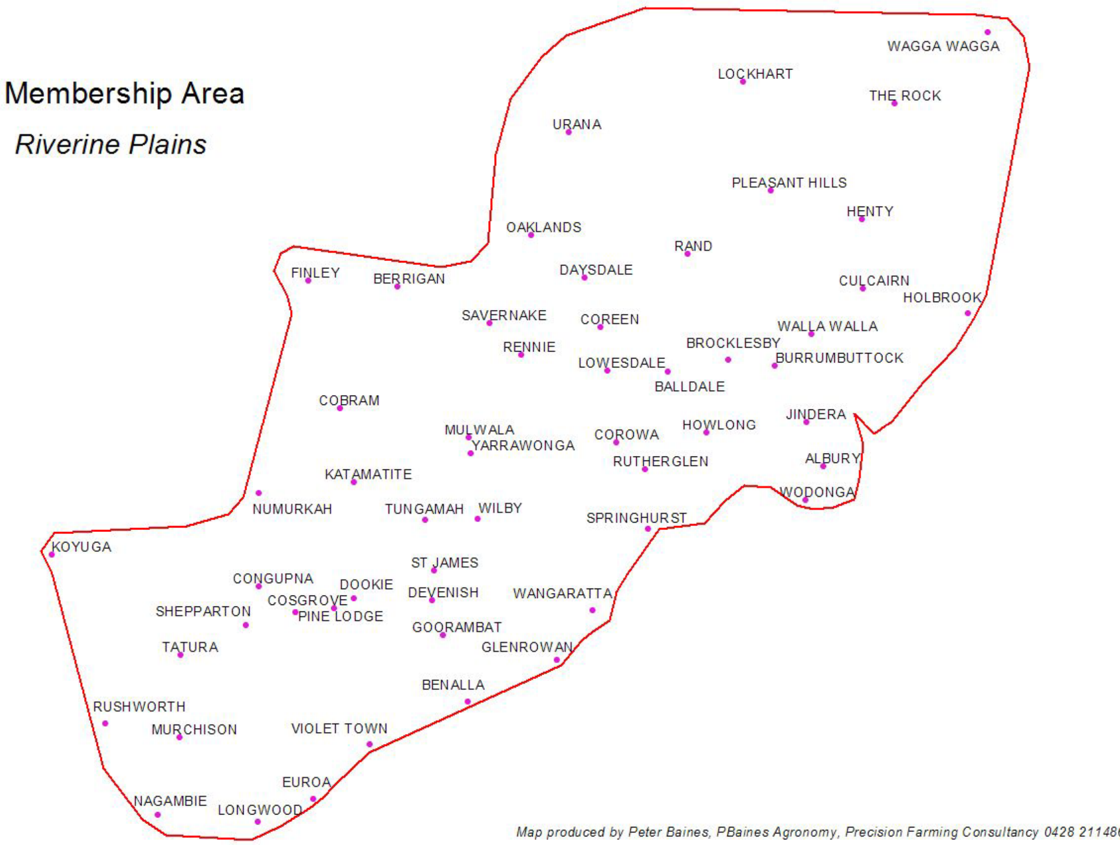
Area Covered by Riverine Plains Inc



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Preface

Trials versus demonstrations - what the results mean

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

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

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

Table 1: Example of a replicated trial with four treatments

	TREATMENT	AVG. YIELD (t/ha)
1	Variety 1	4.2
2	Variety 2	4.4
3	Variety 3	3.1
4	Control	4.3
	lsd ($P<0.05$)	0.5

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

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

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

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

INTRODUCTION

A Word from the Chairman

Adam Inchbold, “Grand View”, Yarrawonga

The challenge for farmers through time has undoubtedly been rising production costs relative to the value of their outputs ie declining terms of trade. Time and again productivity improvements have generally maintained the cost of producing a tonne of wheat relative to its value at a fairly stable figure (around one third of the value of a tonne of wheat).

The productivity improvements that have been achieved by Australian farmers are well known, with the much talked about 3% increase p.a. generally being accepted as being the rule. However, in recent years, the cost of producing one tonne of wheat has risen to around one half the value of a tonne of wheat. Hence, the general improvement in productivity has been unable to keep pace with the actual increases in input costs. This is a real concern!

Average wheat yields achieved by Australian farmers can be charted from the beginning of farming in Australia. This trend shows that aside from small gradual improvements in productivity, there have been significant jumps along the way, effectively ‘shifting the production curve’, rather than just moving along it. Examples of these jumps in the past include the breeding of the first line of wheat ‘federation’, the introduction of sub-clover into the rotation, and the commencement of the use of superphosphate.

With the ever burgeoning costs of production, it is vital that Australian farmers continue achieve the 3% increase p.a. So, it is important to turn our minds to how this might be achieved in the future. In theory it can be achieved by a large, significant strategy to eliminate an important factor that is currently constraining production, or it can be achieved by a suite of tactics resulting in small, more frequent productivity improvements.

With each improvement the next steps become increasingly difficult. Sometimes we find ourselves investing in inputs that result in little improvement in actual yield resulting from an input or a season that fails to deliver. It is important therefore that when considering input decisions we maintain our objectivity and don’t go grasping at straws to find some new way to help, but also have the independent information that makes for good decisions. Generally speaking though, as we have seen in recent years, the small gradual improvements become less likely to improve productivity as we move further along the response curve, as factors such as lack of rainfall begin to limit yield more often. So, it may be that we need to shift the curve to a new level, rather than just move along it.

To shift the productivity curve, however, factors that have a large constraining influence on production need to be overcome. This can be an exciting challenge, but over the years only a few of these large improvements have come along. Firstly, they require a considerable leap of faith by researchers and funding bodies to invest over many years in investigations leading to the improved strategies and technologies being worked out. Secondly, the validation and demonstration of these strategies and technologies at the paddock level also takes time, and then the adoption of what is often a radical new approach can be slow. Think of how long it took for direct drilling to become the norm across the Riverine Plains.

The above difficulties however do not represent justification for not making attempts at finding significant ways of overcoming factors that are currently constraining production. Think of where we would be if some of those landmark practices that we now take for granted were not worked out over a period of many years in the past. In fact, when the chips are down there are more and more reasons to work hard at improving the system.

Perhaps one of the most important things at this time is that all parts of the chain work together to facilitate good discussion and then good decisions being made. Riverine Plains Inc is helping improve farming system productivity. It is important that we take part at a number of different stages in the chain, whether it be undertaking project work ourselves, being part of larger projects, transferring technology or sharing information.

Specifically a few highlights from the last twelve months include:

- Successfully running two GRDC farmer updates, with the latter one held in February this year being one of the most successful in terms of numbers attending, held in the country.
- The ‘come and see’ air-seeder day.
- The continuation of the GRDC funded project ‘Zonal Management in the Riverine Plains’. Results from this project can be seen in many publications including this one.
- The establishment of the Precision Ag Discussion group in 2004, which facilitates discussion of PA issues in general, including results from the zonal management project.
- Pilot studies into strategies aimed at improving crops grown on wheat stubbles ‘the third crop project’, and preliminary investigations into the potential for IPM of broadacre winter crop pests across the Riverine Plains. Results from these pilot studies can also be seen in this publication.
- The spring field day, particularly addressing the stripe rust issue which was so important at the time.

Additionally, one of the biggest highlights from the last twelve months was the WA No-till tour. This tour, available only to members of Riverine Plains, exposed the participants to some leading farmers, consultants and researchers, and feedback from participants has been extremely positive. Perhaps one of the most important reasons for its success though was the simple fact that 42 Riverine Plains members spent a week together on a bus (which I admit at first suggestion sounds a little bit claustrophobic), allowing much learning (and laughter), simply from sharing such a large amount of time together in such good spirits. This highlights one of the other important roles that Riverine Plains Inc can play in the community. That is, simply getting people together.

We look forward to not only continuing our involvement in the above activities, but also expanding what we can deliver to our members and the broader agricultural community in the future. We hope that you will all find some positives for your own situations from the group, even if it’s just the positives that come out of getting together with a diverse group of people and having a chat.

As always, Riverine Plains Inc has benefited from so many outstanding contributors over the past year. Indeed, it is important not to underestimate the amount of work required to make an organization that now turns over more that $200,000 p.a. successful and sustainable. The committee continue to make a huge contribution to the group. For some years now, we have run within the committee a series of sub-committees, meaning that all members of the committee have hands on involvement in some part of the group's program. The Victorian and NSW DPI continue to make an invaluable contribution to Riverine Plains through sitting on the general committee as well as contributing to specific projects and events. Riverine Plains Inc has also continued to gain outstanding support from its financial sponsors. Looking back now, the support we have received from sponsors from the very beginning has been amazing, considering where we started from. They are a big part of the group's financial self-sufficiency, a critical attribute. Moreover, the individuals that represent the companies are all keen agriculturalists and make important contributions to the committee from this additional point of view.

Finally, it would be remiss not to note the contribution made to Riverine Plains Inc by David Cook. David was an inaugural member of the Riverine Plains Inc committee. In the early years of the committee, David soon became chairman of the group, and continued in this role until early this year. Riverine Plains Inc undoubtedly owes David a debt of gratitude for his contribution to the group over this time.

Insert Elders Ad

Annual Report for the Albury Agronomy District - 2004

Author: John Francis

Contact No: 02 6041 6500

Organisation: NSW DPI, Albury

Note: Rainfall and weather data sourced from the Bureau of Meteorology and Australian Rainman Streamflow Version 4.

It was a hot and dry start to the year with January to April rainfall totals of between 25-50mm, approximately 30% of the LTA. May to September rainfall was close to the median but October rainfall was well below average which, when coupled with the lack of subsoil moisture, led to significant crop yield loss across the district. November rainfall was too late to be of significant benefit to crops and December rainfall resulted in weather damaged grain.

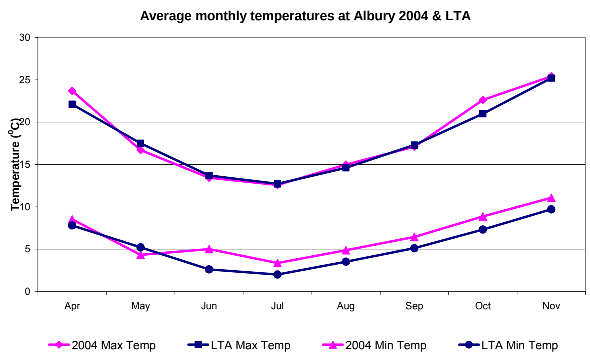


Figure 1. Average monthly temperature at Albury 2004 & LTA

Average maximum monthly temperatures for 2004 (Figure 1) tracked closely with the long-term average but average minimum monthly temperatures were above the LTA reducing the number of frosts for the year (Figure 2).

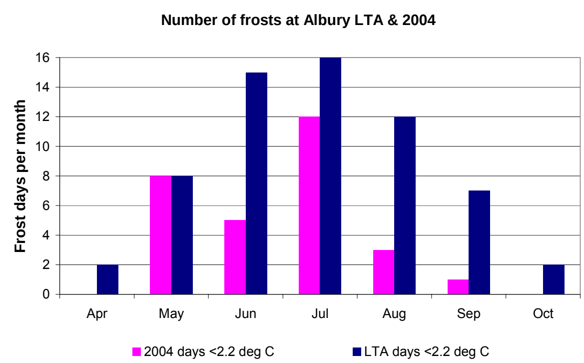


Figure 2. Number of frosts at Albury LTA & 2004

Weather Summary:
Total rainfall for 2005 was around 20-25% below long term average (LTA) for most towns in the Albury district. Figures 3 to 9 provide an insight into total and growing season rainfall received in 2004 compared to LTAs.

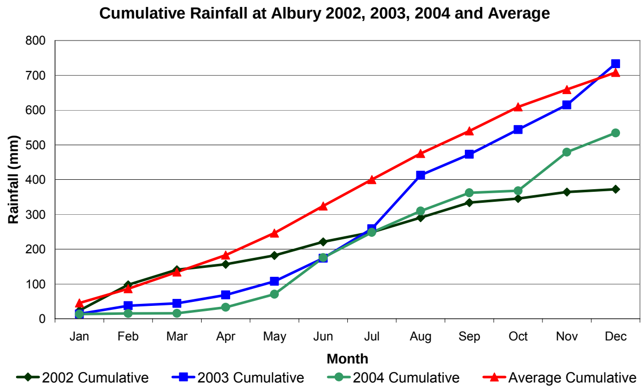
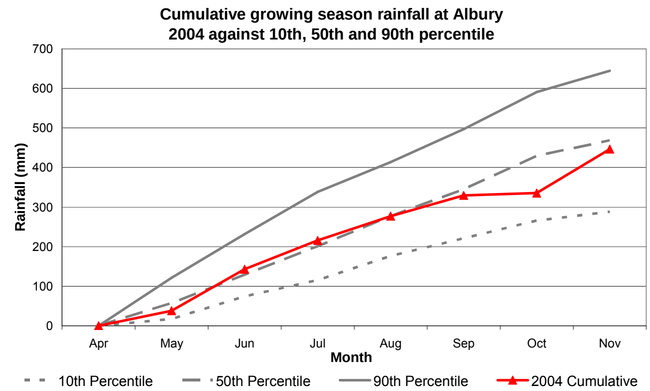


Figure 3.



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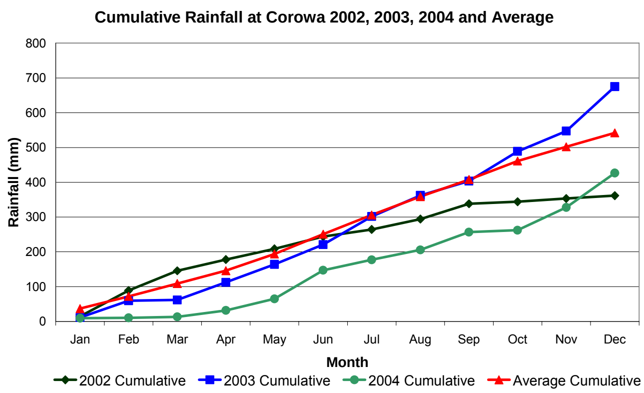

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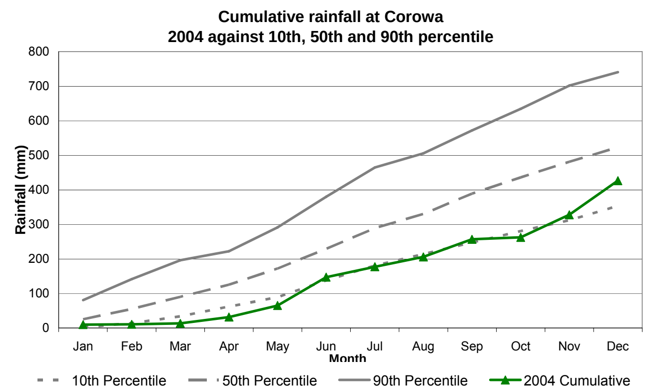

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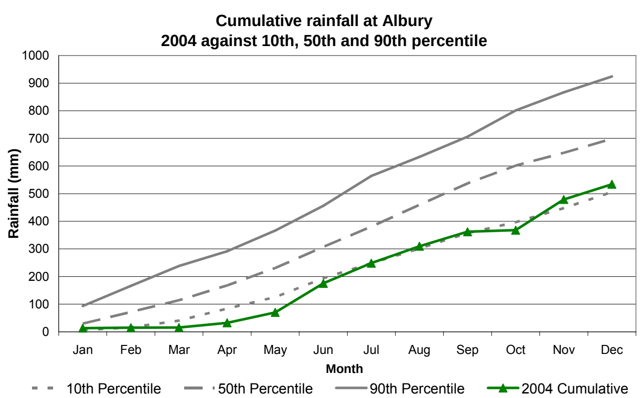

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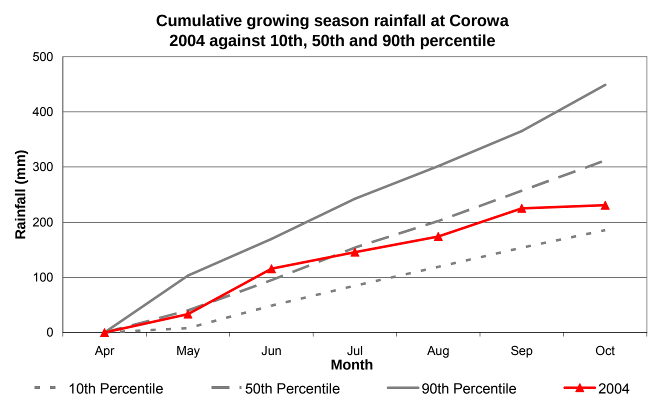


Figure 8.

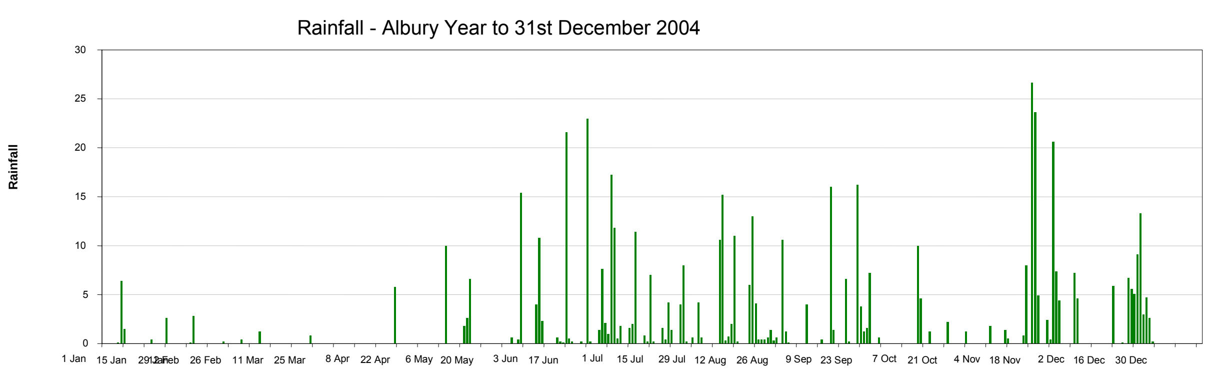


Figure 9.

Cropping:
There was very little subsoil moisture leading into the cropping season with very little rainfall recorded for the year to the end of April. The autumn break occurred on the 19th May but possibly 50% of the total area plantings were sown dry, or on marginal moisture, prior to this date.

Dry sown crops emerged evenly, thereby avoiding management problems associated with patchy emergence. Dry sown paddocks had significant early weed pressure with wild oat, brome grass and barley grass levels severe in wheat, and wild oat and self sown cereal pressure high in pulses and canola.

May and June growing season conditions were ideal with the number of frosts for June far less than the long term average.

Insect pressure was severe in June with red legged earth mite present in very high numbers in canola, pulses, cereals and pastures. Weevil (Mandalotus and Sitona) damage in canola was also high in isolated instances.

A week of severe frosts in mid July slowed the growth of crops and pastures.

Yellow leaf spot symptoms were widespread in wheat. Sowing depth was a big issue in cereals with significant biomass differences apparent between deep and shallow sown areas of crop. Some downy mildew appeared in canola and blackleg leaf lesions were widespread.

Grazing cereals again proved that they are a valuable crop in mixed farming systems. They provided useful grazing which eased stocking pressure on pastures, and allowed for improved pasture growth rates and pasture recovery after winter cleaning.

Agribusiness agronomists reported the first stripe rust occurrences to the west and north of Corowa in late August. Diamondbird wheat crops were showing the genetic disorder associated with its breeding in August.

Crops in the Albury district still had high yield potential at the end of September. Stripe rust hotspots were showing up readily in susceptible wheat varieties at the end of September. Fungicide supplies were low and there was at least a 4 day wait for aerial fungicide applications.

The hot and dry conditions during October halved wheat and pulse yield potential in the west of the district and dropped it considerably in the east of the district.

There were widespread egg lays and hatchings of heliothis (helicoverpa) during October. Most canola and pulse crops in the district were sprayed. There were some logistical problems with aerial applicators and insecticide supplies.

The November rain was too late and didn't contribute significantly to improved yields after the dry October. It was another financially difficult season for those in the west of the district as input costs were matched to an average season and grain prices were low.

Crops in the east of the district did benefit from the November rain due mainly to better subsoil reserves, more October rainfall and later sowing than the west.

Canola yields were disappointing with westernmost crops yielding around 0.8-1.2T/ha with oil contents in the mid 30 percent range. Yields and oil contents increased as the harvest moved east.

Many canola crops in the east of the district had significant sclerotinia levels with the worst affected crops losing up to 30% yield.

Average wheat yields in the west of the district were around 2-2.5t/ha with screenings ranging from under 5 to over 20%.

Weather-imposed grain quality issues, associated with the excessive December rainfall, appeared to be worse in the western parts of the district than the eastern parts.

Pastures:
Annual grasses and clovers germinated on the mid May break. Perennial grasses, and lucerne, that were well managed, were visibly better in May than those that were overgrazed in the preceding months. Most of the pastures in May were providing around 600kg DM/ha, with well managed perennials doing better.

The majority of pastures in the district were growing at 0-10kg DM/ha/day at the end of June. Supplementary feeding continued throughout the district. Most pastures were heavily stocked and livestock feed demand was exceeding pasture supply.

Severe frosts slowed pasture growth during July. Red legged earth mite pressure was high and many pastures were winter cleaned. Pastures were growing at 0-10kg DM/ha/day at the end of July.

Pasture growth increased significantly in August with an increasing leaf area and increasing daytime temperatures. Winter cleaned pastures started to recover. Pasture growth rates went from 20kg DM/ha/day in the east, to 50kg DM/ha/day in the west of the district.

Pastures were looking very good at the end of September with many producing greater biomass than expected given the late break. Pasture growth rates were 60-70kg DM/ha east of the Olympic way and 70-85kg DM/ha west of the Olympic way.

Many pastures were cut for hay and silage during October. Fodder yields were lower than average which was not surprising given the late start to the season. Pasture growth rates were still around 100kg DM/ha east of a line running from Corowa to Rand. Pasture growth rates dropped significantly for each 5-10km west of that line.

Hay and silage making continued during November. Significant quantities of hay were of poor quality or completely ruined due to the rain. Early cut dryland lucerne paddocks responded very well to the November rain.

While the lack of rainfall in October resulted in decreased pasture growth rates in that month, the November rain was timely enough to extend the growing season.

Perennial pasture growth in the east of the district carried on well into December after the rain. Lucerne stands looked vigorous and were growing rapidly in response to the rain and relatively mild late-December temperatures.

Insert Goldacres Ad

RIVERINE PLAINS INC – RESEARCH AT WORK

Mapping Protein and Utilising Protein Maps

Author: James Taylor[1], Brett Whelan[1] and Adam Inchbold[2]

Contact No: [1]02 9351 2947, [2]03 5743 1749

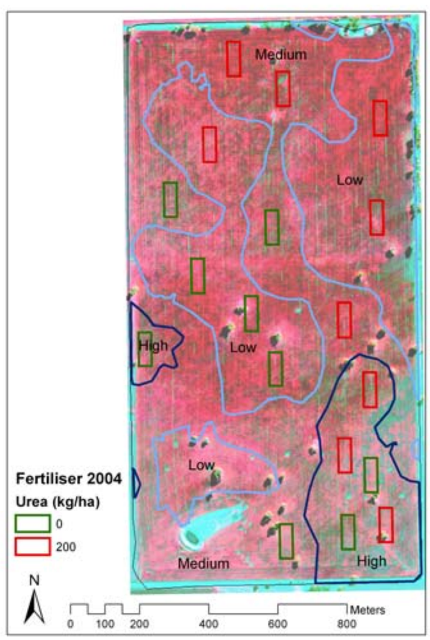
Company: [1]Australian Centre for Precision Agriculture, University of Sydney
[2]Grand View, Yarrawonga

Key messages:

- Protein can now be mapped successfully across paddocks.
- Protein mapping can be a useful addition to the tools available to help manage N inputs more appropriately.

Aim:
In zonal management, yield is only one half of the equation; we are also interested in the protein story. Despite many false starts and promises, protein sensors are almost here, and for the 2004 harvest, Riverine Plains Inc used a NIRTech protein sensor from GPS-Ag.

Method:
As has been outlined in previous papers and discussions, a number of paddocks across the Riverine Plains are being studied in the zonal management project. One of these paddocks, Field 44 at Yarrawonga, has replicated N fertiliser strips overlaid across three zones (Figure 10).



The default N application was 100kg Urea/ha.

Figure 10. False colour image of Field 44 with the management zones and fertiliser trial strips overlaid

In 2004, a wheat crop was grown in Field 44. Along with the many other measurements and investigations that are occurring in accordance with the zonal management project, a protein map was made of the wheat crop, to complement the yield map.

Results:

Protein Monitoring
With a little bit of intensive support from Ed Cay, the protein sensor successfully mapped Field 44, at Yarrawonga. The sensor reads at approximately every 10s intervals and is less dense than yield data (read at 1s intervals). However it is still recording approximately 40 points per hectare. The raw yield points and protein points are shown in Figure 11.

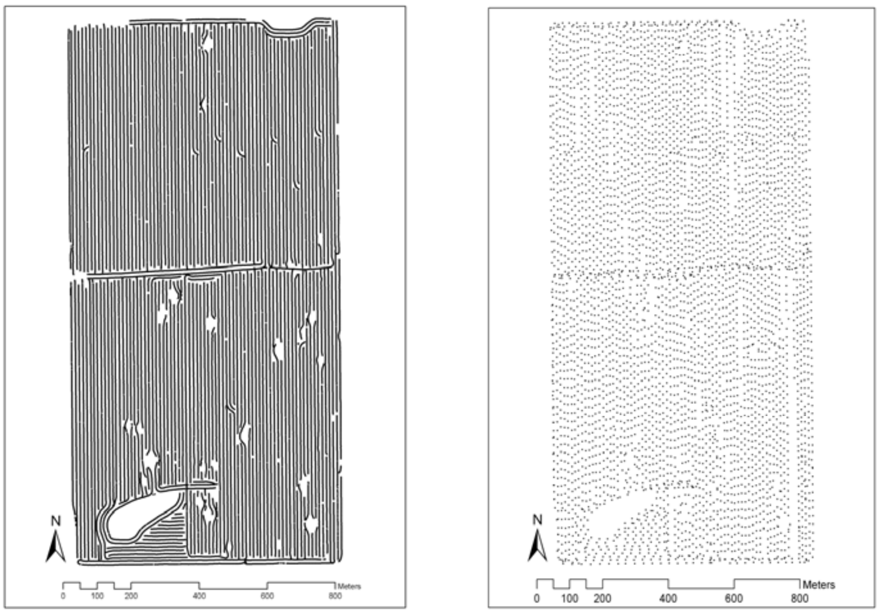


Figure 11. Plot of the locations of the raw yield (left) and protein (right) data points as collected by the on-harvester monitors.

Continuous maps of both yield and protein have been made. The yield map shows greater detail (due to the higher density of data collected) and the location of trees in the paddock are clearly evident from the red hot spots of low yield. The protein does not pick these up however the broad trends in the field are evident and large areas (indicated by the rectangle and ellipse in Figure 12) show that there is a negative correlation between yield and protein in parts of the paddock.

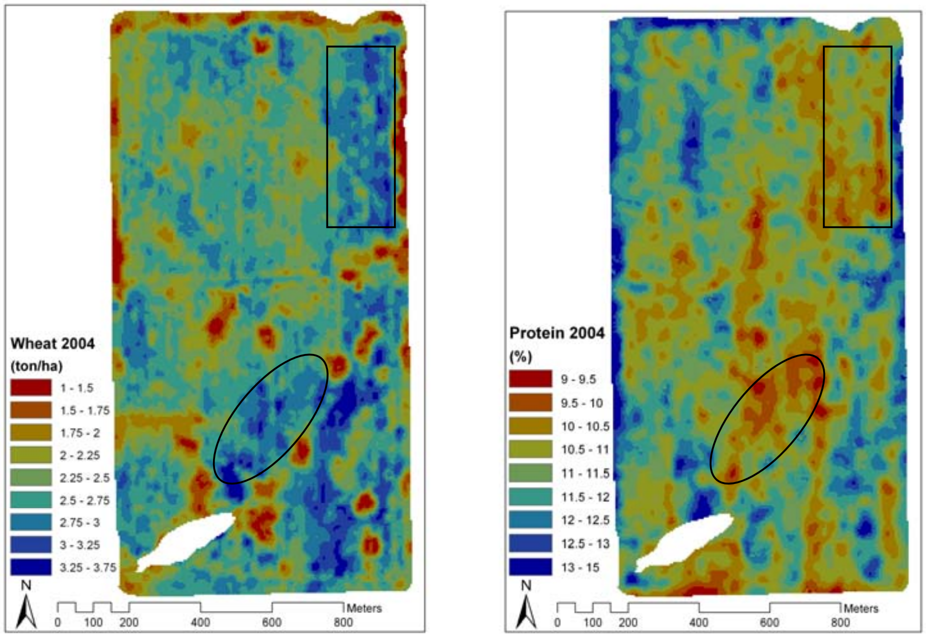


Figure 12. Map of yield and protein for Field 44

Observations and comments:

Yield and Protein Response functions

The current experimental design being trialled by Riverine Plains Inc, in conjunction with the GRDC Precision Agriculture Initiative (SIP09) and the University of Sydney, is aimed at identifying the local response functions within each management zone. Just as we do not expect each zone to have the same yield we also do not expect it to have the same response to different levels of fertiliser. Since detailed data on protein content is also now available, the protein response for the different zones can be calculated as well as the yield response (Figure 13).

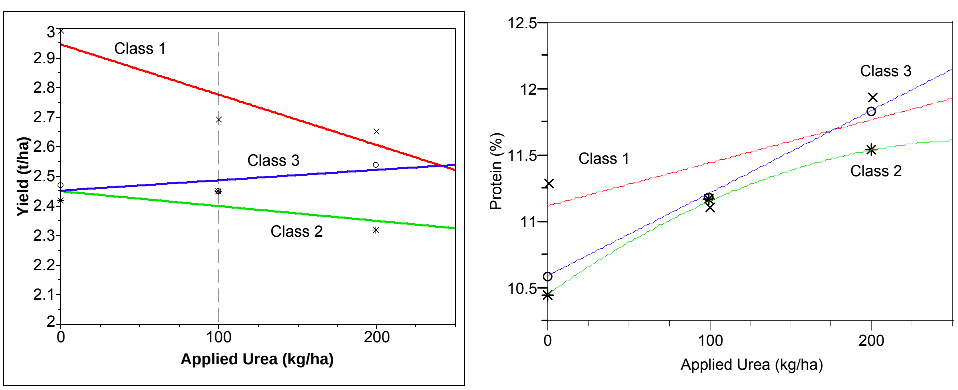


Figure 13. Yield (left) and protein (right) response functions for Field 44 in 2004

For Field 44, in 2004, the farmer initially aimed at a yield target of 3.5t/ha and 11.5% protein. The season had a dry finish which caused areas with vigorous growth (higher N) in Classes 1 and 2 to run out of moisture and prematurely senesce. In Class 3, which has generally poorer soils, the crop was unable to initially utilise the extra N. As a result, even in areas of higher N application, it did not run out of moisture too early. However the extra N did not produce any serious increase in yield.

The protein response shows that while Class 3 yield was not responding to N in terms of yield, the addition of 100 kg/ha of urea raised the protein content by 1% compared to the application of no urea. Class 1 and 2 also have a strong response in protein level to the addition of N.

Table 2 shows the marginal return for each N rate in each zone for Field 44 when yield, protein (resulting in a $/tonne value according to a 'Golden Rewards' matrix), and the cost of the extra N applied are all taken into account. The addition of N to Class 1 and 2 created a trade off between yield and protein. As a result the gross income at best remained neutral with the addition of extra N, and in Class 1 declined due to the fact that the limited protein response was unable to compensate in value of the grain for the reduced yield obtained. Clearly then, the marginal returns resulting from extra N in Classes 1 and 2 were negative. For Class 3, stable yield and increases in protein combined to produce some increase in gross income. However, the increases were too small to justify the expenditure on extra N.

Table 2: Marginal return from extra urea

	100 kg extra urea/ha	**200 kg extra urea/ha**
Class 1	-$56/ha	-$138/ha
Class 2	-$35/ha	-$74/ha
Class 3	-$29/ha	-$36/ha

All in all, it would have been better not to apply any extra N to any of the zones. However, it is still possible to use this data to evaluate the concept of treating zones differently with regard to N, according to each individual's underlying N status. Class 1 for instance had a higher N status than the other zones. This zone also responded the most negatively to the application of extra N. This result lends support to the concept that Class 1, as in 2003, was the least likely zone to require N, and in fact for the past 2 years the addition of extra N to this zone has produced a loss.

Class 3 responded less negatively than Class 2 to the addition of extra N in spite of the fact that Class 2 had less underlying N than Class 3. A possible explanation for this is that Class 3 has the ability to store more soil moisture than Class 2, and so could utilise more of the applied N, and not suffer a yield penalty compared to Class 2. This is different to the 2003 results where Class 2 was the most responsive zone to extra N due to its low underlying N status but also a growing season where showers through the early spring kept the soil profile (even in this low water holding capacity zone) relatively moist.

Nitrogen Budgeting

For farmers, one of the principal benefits of a protein monitor identified by Australian growers is the ability to better identify nitrogen use within fields and variably replenish nitrogen in the subsequent crop. The amount of nitrogen removed from a system depends on the amount of grain (yield) and the amount of nitrogen in the grain. For Australian conditions the relationship between protein, yield and nitrogen removed in wheat is approximately

$$\text{N removal (kg/ha)} = \text{Grain Yield (t/ha)} \times \text{Grain Protein (\%)} \times 1.75$$

Since we have continuous maps of both yield and protein data, from on-the-go sensors, a map of the nitrogen removed from the cropping system can be produced using the above equation (Figure 14).

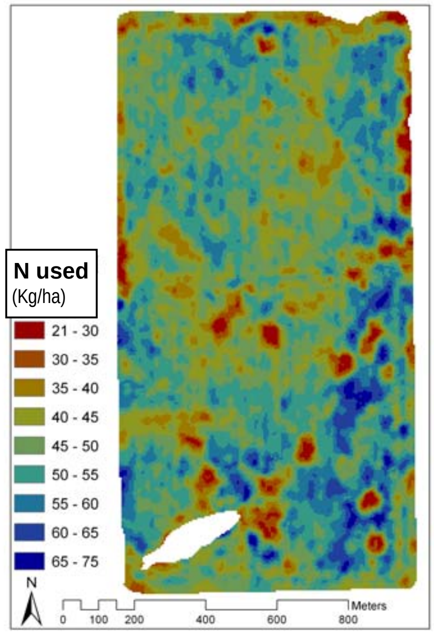


Figure 14. Map of Nitrogen removed from Field 44 (derived from the yield and protein maps)

In an ideal situation, where soil N was optimum for plant growth, this map should be the N application map for the subsequent year. However the residual N in the soil and the rate of N loss to the environment need to be accounted for when making fertiliser maps.

Currently the ability to cheaply produce a continuous map of soil nitrogen prior to fertilizing or a site-specific model of N loss are not available, so the ability to produce a map of N usage is likely to be useful for establishing N prescriptions. However, it is also important to note that the above highlights the reason for the current focus on zone management at this stage. That is, the N status of zones can be established using conventional soil testing techniques, which is at least an improvement compared to the traditional approach of taking paddock averages.

Sponsors: GRDC, ACPA, Riverine Plains Inc.

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

Author: Peter Baines

Contact No: 0428 211 486

Company: Tim Paramore Agronomic Services Pty Ltd, Albury NSW

Key messages:

- Lighter textured soils (low zone) had an average of 11kg less nitrogen (N) /ha or 0.3t/ha potential less grain yield than the heavy soils (high zone).
- The average range of N within a paddock (common soil type/zone) was 45kg N/ha or 1.2t/ha of potential grain yield.
- Comparison between 2004 and 2003 DSN results show that sites were successfully selected (consistent DSN results to soil types) using electromagnetic surveying and yield mapping data.

Aim:
To identify the deep soil nitrogen (DSN) status across three zones (soil types) 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. Within five metres of each sample site three 0-60cm cores were collected using a hydraulic ram soil sampler and solid 48 mm soil corer. A sub sample of the three cores was then sent to CSBP soils laboratory in Western Australia 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 82 to 203 kg N/ha (Figure 15). Statistics (analysis of variance) indicate no significant difference across replications (DSN values consistent within each zone), but significant differences occurred between the zones ($P < 0.05$). Average DSN results indicate that the high, medium and low zone each had 140, 143 and 132kg N/ha respectively.

Further statistical analysis (least significant difference $P<0.05$, 14.9kg N/ha) showed that the average difference in DSN within paddocks (between the zones) was 45kg N/ha with a range of 26 to 98 kg N/ha.

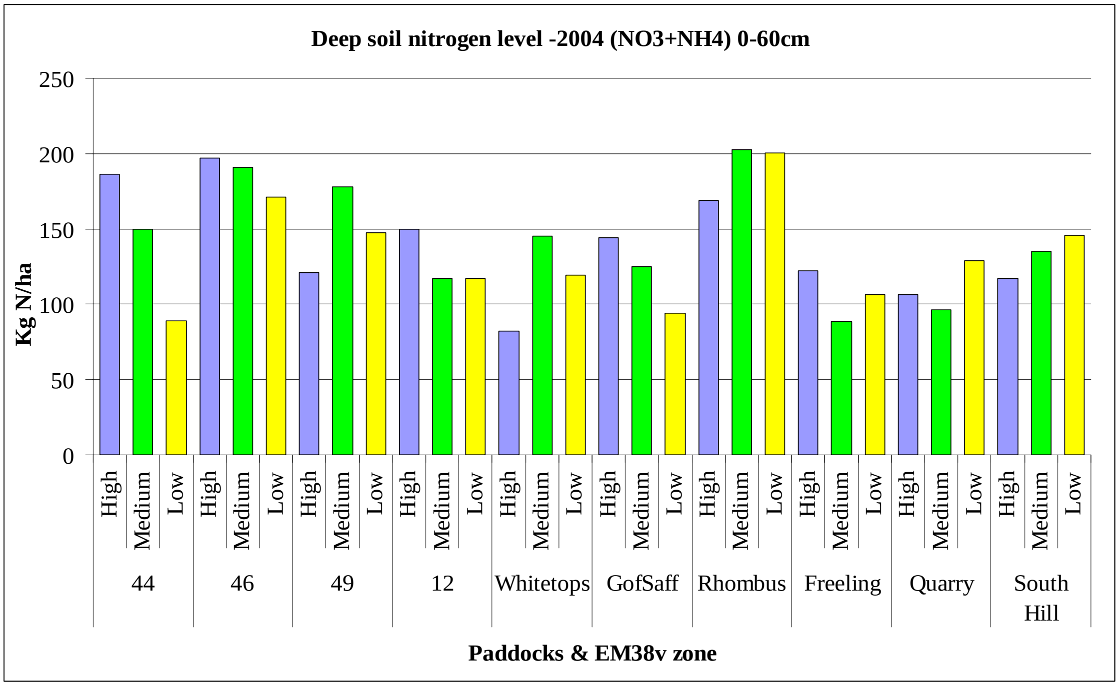


Figure 15. Deep soil nitrogen

2004 and 2003 results:
Comparison between 2004 and 2003 DSN results indicate no change in levels for the low zone, but increased levels in the high (26 kg N/ha) and medium (29 kg/ha) in 2004. The difference between zones reduced marginally from 50 to 45 kg N/ha and the range within paddocks also reduced, from 100 to 72 kg N/ha (see Table 3).

Table 3: 2004 and 2003 DSN results (kg N/ha)

	2003	2004
High EM38v	114	140
Med. EM38v	114	143
Low EM38v	132	132
Lsd ($P<0.05$)	17.8	14.9
Statistics between zones in each paddock		
Difference	50	45
Range	11 to 111	26 to 98

Observations and comments:
These results indicate the importance of collecting DSN according to soil types to enable N inputs to better relate to soil status. These DSN results show significant variation between paddocks and zones but not within a zone (common soil type).

The results support the identification of the zones through electromagnetic surveys and yield mapping. Targeting of DSN to zones will provide more consistent results, and thus enable N inputs to be allocated more appropriately.

Individual paddock variation is strong and no single zone has a dominant amount of available N. This suggests that it is necessary to identify at least three zones for the collection of accurate DSN results for precision farming.

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

Sponsors: GRDC, ACPA, Riverine Plains Inc.

Insert Rural Finance Ad (same as p97 last year but reduce size to 190 x 167mm)

Early investigations into variations in yield potential within fields: soil variability and soil-moisture profiles

Author: James Taylor[1], Brett Whelan[1] and Adam Inchbold[2]

Contact No. [1]02 9351 2947, [2]03 5743 1749

Company: [1]Australian Centre for Precision Agriculture, University of Sydney
[2]Grand View, Yarrawonga

Key messages:

- Important soil parameters that potentially limit crop production vary significantly within field.
- Soil-moisture measurements taken during the 2003 growing season indicate that some yield variation is being driven by the crop's access to stored moisture.

Aim:

In Australia, crop production is strongly linked to moisture availability in the form of rainfall, subsoil storage and subsoil accessibility. In Southern Australia, even when within-crop rainfall is adequate, large yield differences are still being observed within paddocks. It is hypothesised that the lower yielding areas are being moisture limited by the inability of crop roots to penetrate the subsoil and access the stored moisture.

Additionally, Riverine Plains Inc, has previously identified variation in important soil parameters within paddocks. In 2004, an effort was made to physically survey the characteristics of the soil across several of the project paddocks at Yarrawonga.

Methods:

Two paddocks, Field 12 (27ha) and Field 44 (130ha) near Yarrawonga were selected to test the above hypothesis. Both fields were surveyed by a Geonics EM38® and segregated into three 'management zones', low, medium and high (Figure 16). In Field 12, two Gopher® soil moisture measurement tubes were installed in each 'management zone' while Field 44 received four Gopher® tubes per 'management zone'. Each Gopher® tube location was geo-referenced. The Gopher® tubes were manually read at approximately 1-2 week intervals from April to December and the soil moisture recorded at 100mm intervals down the profile to a depth of 1m.

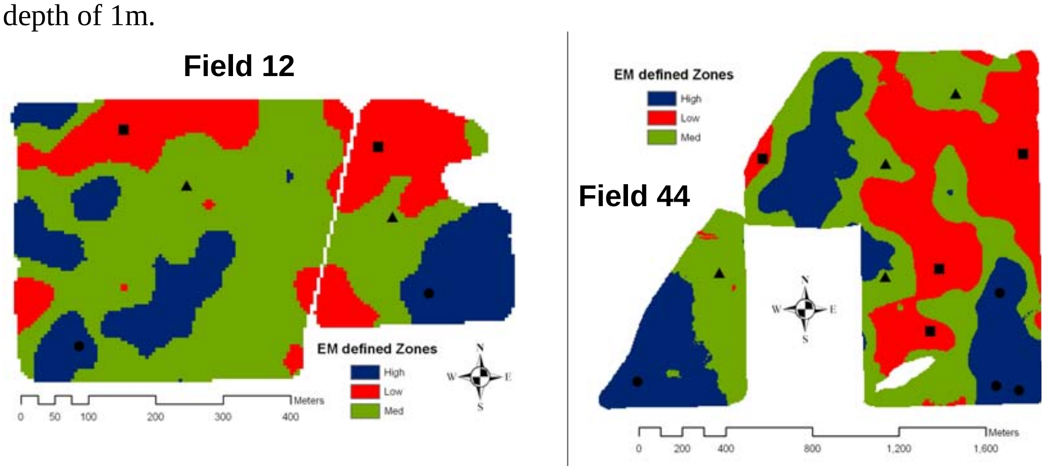


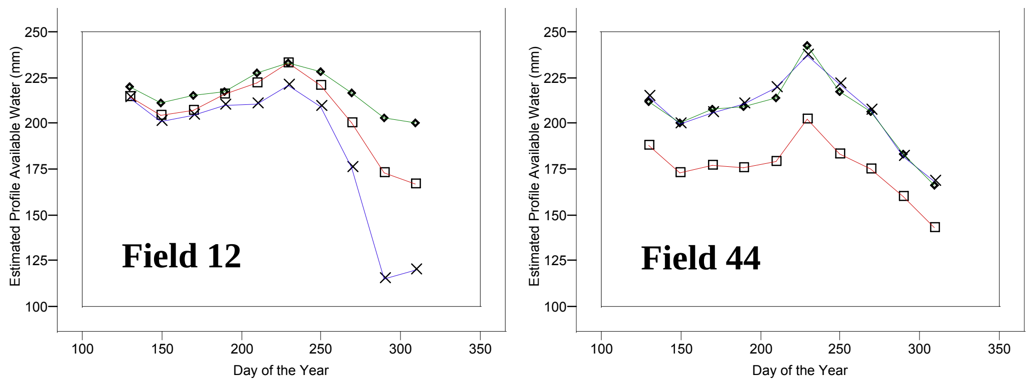
Figure 16. Management Zones and Gopher® locations for the study fields

At the end of the growing season the field was harvested and yield monitor data interpolated onto a $5m^2$ grid.

The Gopher® data was averaged for 20-day intervals and the soil moisture content calculated for the topsoil (0-400 mm), subsoil (400-1000 mm) and whole profile (0-1000 mm). Plots of whole profile soil moisture content are shown in Figure 17 for both fields. The mean yield response for each management zone and the mean yield response of the gopher locations within each management zone are given in Table 4.

During the 2004 growing season, a traditional soil survey was also conducted. The survey evaluated the soil monitoring sites already existing in the projected paddocks using all of the known systems of classification including Isbell, Northcote and Great Soil Groups.

Results:
Results from moisture monitoring in 2003 are shown in Figure 17. More water was extracted from the High Zone (blue line) in Field 12 than the Medium and Low Zones. In Field 44 a similar amount of water was extracted from all three zones, although the Low Zone had less water to begin with.



Blue = High Zone, Green = Medium Zone and Red = Low Zone

Figure 17. Graphs of the change in Profile Available Water (mm) for the three management zones as the growing season progress

Yield maps were made of Field 12 (wheat) and Field 44 (canola) in 2003. The yields for individual zones are shown in Table 4.

Table 4: Mean wheat yield (t/ha) from 2003 Canola crop for management zones and at Gopher locations within management zones.

	Yld 12		Yld 44	
	Zone Mean*	Gopher Mean^	Zone Mean	Gopher Mean
Zone 1	1.7	2.22	2.3	2.27
Zone 2	1.96	2.66	2.36	2.3
Zone 3	2.58	2.76	2.35	2.38

Observations and comments:
There is some interesting variation between zones. The properties of the topsoil remained similar across much of the area surveyed, however the sub-soil changed significantly as the soil surveyor moved down the slope from the tops of the hills through the mid slope to the points of lowest elevation. The sub-soil characteristics of greatest interest for analysis are:

1. The presence of sodicity in the profile where soil aggregates disperse;
2. Soil permeability.

On the tops of the hills, the topsoil basically overlaid a mix of B/C horizon (partially broken down parent material) with no A2 horizon present. Moving down the slope, an A2 horizon became present (chromosol), and then more pronounced. As this was happening the sub-soil became clay content increased and eventually became sodic (sodosol).

The change in soil type may have a marked influence on production, giving rise to the potential to target different levels of production. It is hoped that an understanding of how these vary across the paddock will provide a key to identifying when and where the crop runs out of available soil water in drier seasons, and where areas of superior drainage benefit in wetter seasons.

The yield results in Table 4 indicate that there was not a significant difference in mean yield between management zones in Field 44 (either as a zone average or as a Gopher location average). The plot of available moisture for Field 44 (Figure 17) indicates that the crop in each management zone used a similar level of water, thus a consistent yield is not unexpected (in the absence of any other strong yield determining factors). However, the Low Zone is less capable of storing moisture, and in drier years may be expected to run out of water first and suffer yield loss. For Field 12 the Zone mean was significantly different ($p<0.05$) for the High Zone, which yielded higher than the other two zones. Figure 17 shows that the High Zone accessed more profile moisture. The low yield response in the Low and Medium Zones appears to be due to the crops inability to access the subsoil moisture rather than a lack of moisture.

By using some prior knowledge (EC_a data) and a zone-orientated approach, issues with crop access to soil moisture have been identified with only a limited, and economically viable, number of soil moisture measurement tubes. Further soil testing is needed but the results indicate the usefulness of getting in touch with the variations in important soil properties across the paddock, and the potential to use within-season moisture monitoring to aid in the development of an understanding of the potential for different zones in paddocks to yield.

This is an area that represents the next step in zonal management. If farmers know which zones have a higher production capability, different yield targets can be allocated to individual zones, resulting in a more sophisticated and more appropriate fertiliser strategy. However, it is important to remember that a very sophisticated variable rate fertiliser strategy requires good knowledge of paddock variability to guard against costly errors. This knowledge will be built up over time. At this stage, it would seem that there are a number of simpler steps that should be taken by farmers getting into zonal management that don't necessarily require such a comprehensive understanding of their paddocks eg variable rate lime and gypsum applications.

Sponsors: GRDC, ACPA, Riverine Plains.

Insert GPS Ad

Third crop work gives results

Author: John Sykes

Contact No: 02 6023 1666

Company: John Sykes Rural Consulting, Albury

Key messages:

- The application of N increased yields of all cereals grown on a wheat stubble.
- The application of fungicides controlled leaf diseases in wheat and barley, and increased the grain yield of wheat.

Introduction:

Farmers in southern NSW and NE Victoria have reported that yields achieved from the alternate cereal crops, barley and triticale are almost always lower than those obtained from wheat. The lower yield from barley and triticale is also recorded in a number of regional databases that collect on-farm yields. Lower yields for barley are demonstrated in local variety experiments but the available yield comparison experiments show that triticale should yield better than wheat.

At the same time, they have reported growing a second wheat crop after canola without loss of yield. There has been little experimentation to support the development of yield packages for wheat following wheat after canola.

In 2004, Riverine Plains Inc started a pilot experiment program to examine the options for crops after growing wheat in the commonly used canola and wheat rotation. The program was given the name of the ‘Third Crop Program’.

Aims:

- To examine the cereal crop options that could be used after wheat including another wheat crop or growing barley or triticale.
- To start to examine packages for maximising yield from these crops.

Methodology:

The experiment was established on Graeme and Rhonda Hick’s farm, “Buccleah Villa” Burraja on the 2nd June 2004 using equipment supplied by Serve-Ag Research and operated by its local representative and agronomic researcher John Seidel, from Walla Walla. The soil was a Red Chromosol (red loam) with a pH of 5.1 ($CaCl_2$). Fertilizer included 42 mg/kg of phosphate and 57 kg/ha of Deep Soil Nitrogen prior to sowing.

The varieties used were:

Wheat:	Diamondbird
Barley:	Gairdner
Triticale:	Koscuisko
	Tahara

The treatments imposed on the above are shown in Table 5.

Table 5: Treatments applied to each of the cereals

Number	Treatment Name	Nitrogen Applied (Fungicide Applications)
1	Farm	N 25
2	Farm + Higher N	N 40, (1x Tilt @ Z40)
3	High N	N 60
4	High N plus fungicide	N 60, (2xTilt @ Z30 & Z40)

Results:
Table 6 shows the results of the 2004 experiment. The barley results have not been included because of the amount of weather damage that many of the barley plots experienced between ripening and harvest made yields unreliable. Water use efficiencies (WUE) were generally medium to high.

Table 6: Results of the 2004 Third Crop Experiment

Species	Treatment	Yield (t/ha*)	Protein (%)	Screenings (%)
Wheat (Diamondbird)	1	1.63	9.0	4
	2	2.16	8.7	2
	3	2.62	12.8	5
	4	3.32	13.4	12
Triticale (Koscuisko)	1	2.39	9.3	
	2	2.89	9.1	
	3	3.02	12.0	
	4	3.70	13.5	
Triticale (Tahara)	1	2.17	9.7	
	2	2.63	9.0	
	3	3.01	12.2	
	4	3.05	12.7	

LSD - Yield (0.05) 0.45 t/ha, Protein (0.05) – 3.4%, Screenings (0.05) – 5%
***Notes** – 23 kg/ha of P applied to all plots at sowing as 110 kg/ha of MAP. N applied as MAP at sowing and Urea at Z30. Treatment 2 had Tilt applied at Z40 (heading) to control any stripe rust in the wheat. Seed Dressings - All seeds were dressed. The wheat was treated with Jockey® and the barley and triticale was treated with Baytan®.

The results show:

- Wheat yield rose with applications of nitrogen and fungicide applications.
- Wheat protein rose with extra nitrogen applications.
- Extra nitrogen and the application of two fungicides raised the screenings in wheat.
- Koscuisko triticale yielded better than wheat or Tahara triticale.
- Applications of nitrogen increased the yield of all the cereals.
- Application of two fungicide sprays raised the yield of the wheat and the Koscuisko triticale. It did not raise the yield of the Tahara triticale.
- Due to the low rainfall in 2004, yields were generally low.

Observations taken during the growing season showed that two applications of Tilt® controlled all the leaf diseases of the barley and wheat.

2005 Work
Subject to finances becoming available, the experimental program will be upgraded in 2005 to include:

- Other crops, like canola, lupins and faba beans.
- Additional experimental work to develop the optimal yield for wheat following wheat.
- Additional experimental work to develop the optimal yield packages for the alternate cereal crops.

Sponsors: Riverine Plains Inc.

Integrated Pest Management (IPM) in Riverine Plains Cropping Systems

Authors: Lisa Cary Castleman[1], John Seidel[2] and Paul Horne[3]

Contact No: [1]02 6920 8557, [2]0429 039 322 and [3]03 9710 1554

Organisations: [1]NSW DPI, Lockhart, [2]Serve-Ag Research and [3]IPM Technologies

Key Messages:

- Farming practices and associated insecticide use can harm the pest/beneficial complex leading to a predominance of certain pests such as lucerne flea, earth mites and aphids.
- Farmers need to be aware of the presence of beneficial species in their paddocks and how to identify them.
- A survey found a promising number of beneficial species, particularly the carabid beetles.

Background:

Many farming practices rely on the use of insecticides to ensure crop and pasture establishment free of pests and good crop health with fewer insect vectors to spread disease. Despite the widespread use of insecticides, we still have recurring problems season after season with common pests such as earth mite, lucerne flea and aphids. While some pests are more problematic in one season compared to another, lucerne flea have become a more consistent problem. Are they representative of an imbalance in the agricultural ecosystem?

We need to improve the decision making process in our use of insecticides. Are we using them wisely? Are we unbalancing the system by using insecticides that disrupt the function of natural predators? To provide basic data to help formulate future research directions a survey of selected paddocks was undertaken in 2004 to try and qualify the presence of beneficial species present in our farming system.

Aims:

1. To survey four basic paddock environments to provide a general understanding of the pests and beneficials present.
2. To identify the major beneficial species present.
3. To determine the level of slug activity in these environments.

Method:

Four pasture/crop environments were selected from Riverine Plains Inc members in the Walla Walla district of southern NSW and surveyed in late winter and the spring of 2004 (Table 7).

Table 7: Survey of selected paddocks to qualify the presence of beneficial species

Situation	Site	Paddock History	Insecticide Use In 2004
Unsprayed pasture	Paul Star "Eureka"	Pasture for 5 years - no insecticide use. 04 Pasture: composition - 70% grasses, 5% subclover, 25% weeds	Nil
Crop/pasture rotation	David Paech "Parkside"	02 Triticale 03 Pasture 04 Pasture: composition - 65% grasses, 15% clover, 25% weeds	Nil
Wheat crop	Graeme Wenke "Tara South"	02 Wheat 03 Canola 04 Wheat	Nil
Canola crop	David Paech "Parkside"	02 Pasture 03 Wheat 04 Canola	Endo 500 ml/ha at sowing, Dimethoate post emergence

Collection was made by two methods - vacuum sampling and pitfall trap samplings.
Slug numbers were monitored by the use of shelter traps.
Paul Horne of IPM Technologies identified the pests and beneficials present in the samples.

Table 8: Rainfall in 2004 for Walla Walla

Month	Rainfall (mm)
January	17.0
February	1.4
March	0.6
April	23.2
May	49.6
June	75.4
July	54.0
August	67.4
September	47.8
October	21.8
November	83.4
December	64.6
Long Term Average	632.0

Results:

Table 9: Occurrence of the major pest and beneficial species across the surveyed paddocks

Species	Pest /Beneficial	Unsprayed pasture	Crop/pasture rotation	Wheat crop	Canola crop
Earth mite	Pest	√	√	√	-
Lucerne flea	Pest	√	√	√	-
Pasture snout mite	Beneficial	√	-	-	-
Carabid beetle - 5 species	Beneficial	-	-	-	√
Slugs	Pest	-	-	-	-
Native earwigs	Beneficial	√	-	-	√
Staphylinid beetles	Beneficial	√	-	-	√
Anthicid beetles	Beneficial	√	√	√	√

Key to Table: √ present - absent

There are at least five species of predatory carabid beetles in the samples collected. These were:

Geoscaptus leavissimus
Catadromus spp.
Clivinia SP 1
Clivinia SP 2
Carabid SP 1

Some of these species are common elsewhere in south-east Australia but others are unique to this area and are probably locally important. To find this number of beneficial species with such a short duration of sampling in this project is extremely encouraging. It is likely that more species of beneficials would have been collected with a longer sampling time.

The carabids are commonly known as ground beetles. They have a wide range of sizes and colours – black-and-shiny, coloured, metallic and hairy (Figure 18). Both the adults and larvae are carnivorous and predatory and some species are known as the “caterpillar hunters”. They are also an important predator of slugs and snails.

Figure 18. An example of a Carabid Beetle

The absence of slugs at all sampling sites was not surprising considering the relatively dry season experienced to date in 2005.

The pasture snout mites are native predatory mites that feed on lucerne flea and mite pests. There are potentially a range of predatory mite species present in our cropping environment that can play a valuable role in the regulation of pest species.

European earwigs are largely known as a garden pest. The native earwig, *Labidura truncata*, can be a valuable ally as it is a predator of caterpillars and can help to balance the ecosystem.

Conclusion:
By identifying the pest and beneficial populations present in our farming system, we can devise strategies to help improve the way we approach pest control decisions. One strategy we can adopt is the strategic use of insecticides working in conjunction with beneficials, rather than a reliance on calendar spraying.

The results from this pilot study will be used to approach GRDC and help formulate a new research effort aimed at devising strategies for integrated pest management.

Sponsors: Riverine Plains Inc, Serve-Ag Research, IPM Technologies.

Insert NAB Ad

Contributions of wheat leaves to yield, some Australian data

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Key messages:

- Some 2004 wheat crops were capable of yielding 62-88% of yield from the head and stem alone.
- The only site that was measured gave a figure of 17% for the contribution of the flag leaf.

Since the onset of the recent stripe rust outbreaks there have been many claims made of the value of the leaves to yield. The most quoted data turned out to be English and estimated the flag leaf to be worth 43% of yield. Some rust models around were also predicting substantial losses from stripe rust. In response to this lack of Australian data TOPCROP decided to conduct some small scale trials of their own.

To simulate stripe rust in a worse case scenario the leaves of plants were torn off at varying times on varying varieties at four sites. Two irrigated sites at Kerang and Katamatite East and two dryland sites at Quantong and Katamatite were tested. Katamatite East and Quontong were sprayed for stripe rust at the 1% infection stage but the warm, dry conditions did not allow further disease development in any of the 4 crops.

In small, unreplicated sites of 50 cm x 2 rows, (Kerang 2m x 2m) all leaves were removed by hand, or had all leaves but the flag ripped off and this was compared to a closely adjacent area of untouched crop. These areas were then hand harvested and threshed. To overcome bias from the small areas cut the unit of yield was weight/head.

Table 10: Summary of yield contribution from each plant component

		Katamatite East	**Katamatite**	**Kerang**	**Quantong**	**England**	**1969 research**
Stage of leaf removal		Head emergence	Half head emergence	Head emergence	Late Boot		
Date		11th October	4th October	7th October			
Variety		Whistler Irrig.	Diamondbird	Chara Irrig.	Yitpi	Winter wheat	S Aust var
Yield (t/ha)		5	1	4	1.5		
Contribution to yield:	Head + stem	62%		72%	88%	24%	51-69%
	Leaves 2&3	21%	26%			33%	25-28%
	Flag	17%				43%	24-30%

Table 10 shows the proportions of yield from the flag leaf, the second plus third leaf and the head plus stem. In comparison to the English data, there was a substantially greater contribution from the stem and head in these crops, between 62-88% compared to the English value of 24%. The only site where the contribution of the flag leaf could be determined was Katamatite East and this was 17% compared to the English value of 43%. Surprisingly leaves two and three contributed significantly to yield at the two sites measured. The proportion of yield provided by the stem and head alone was greater in lower yielding crops. Research from South Australia in 1969 looked at the photosynthetic rate from the same plant parts we tested. Interestingly these figures closely match our data.

As a result of leaf removal at the Kerang site, grain screenings rose by 1%, test weight and protein were also lowered. A comparison of the N uptake by the two crops showed that leaf removal led to 25kg less nitrogen uptaken into the grain per hectare.

At Katamatite removing the second and third leaves led to a 10% reduction in grain weight and a 17% decrease in grains/head. At Katamatite East this reduction was 18% and 3% respectively. At Quantong removal of all the leaves led to an 11% reduction in grain size and a 1% drop in grains/head. At Katamatite East this difference was 32% and 8% respectively. The yield loss from leaf removal was mainly as a result of decreased grain size rather than floral abortion.

It must be remembered that this data shows the effect of the draconian step of instantaneous total leaf removal. Stripe rust does not act like this and leaves can actually photosynthesize and translocate nutrients for some time following rust attack. These numbers therefore show a greater than worse case scenario for the effects of stripe rust attack last season in Northern Victoria.

Insert Syngenta Ad

Euroa fungicide trial

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Euroa
Growing Season Rainfall:
Annual: 455mm
GSR: (Apr-Nov) 347mm
Soil:
Type: Grey Clay loam
pH (H_20): 6.0
Sowing Information:
Sowing date: 4/06/04
Fertiliser: 114kg DAP/ha at sowing
Row Spacing: 25cm
Paddock History:
2004 – Wheat
2003 – Peas
2002 – Annual Pasture
Plot Size: 168m x 7.6m
Replicates: nil

Key message:

- An application of a Flutriafol fungicide applied to a fertiliser at sowing gave little yield to wheat sown after peas.

Aim:

The aim was to determine whether application of a Flutriafol fungicide applied in furrow would give a yield response in a wheat crop at Euroa during the 2004 season.

Method:

Wheat (Drysdale) sown in 168m x 7.6m strips was treated with and without a Flutriafol fungicide (in furrow) at sowing. One strip was on raised beds, whilst the other strips were in the unformed remainder of the paddock. The crop also had two applications of a Tebuconazole fungicide to prevent stripe rust on 17th September and 1st October. Yield was determined using a weigh bin.

Results:

Table 11: Differences between treatments at Euroa

Treatment	+ Flutriafol at sowing	- Flutriafol at sowing	+ Flutriafol at sowing
Land form	Beds	Paddock	Paddock
Plant count (p/m^2)	186	140	140
Tiller count, (t/m^2)	900	672	672
Test Weight (kg/hl)	79.9	80.4	84.0
Protein (%)	10.6	10.6	10.7
Screenings (%)	4.9	5.5	4.4
Yield (t/ha)	**4.52**	**4.22**	**4.42**

Observations and comments:

From the results, we see that plus fungicide treatments yielded 5-7% higher than the nil treatment plot. There were only minor differences between treatments in respect to protein, screenings and test weight.

The Flutriafol fungicide (in furrow) is registered for control of take all, stripe rust and septoria, and its use may have delayed the onset of disease in the treated plots, hence increasing yield. The grower did not observe disease in either plot, but applied foliar fungicide on two separate occasions to ensure stripe rust did not develop. As such, the disease response can't be reliably measured.

Yield differences are unlikely to be due to late developing stripe rust or Septoria, which should have been controlled by the foliar fungicide. The difference may be due to take-all, although its presence in the paddock after peas is unlikely.

Since the treatments were not replicated, it is difficult to attribute yield variations to a single factor, and is instead possible that differences were due to paddock variation.

Sponsor: Farmer co-operator; Don Hunt.

Wheat fungicide trial (stripe rust) – Congupna

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Congupna
Growing Season Rainfall:
Annual: 375mm
GSR: (Apr-Nov) 317mm
Soil:
Type: Grey Clay loam
pH (H_20): 5.8
Sowing Information:
Sowing date: 30/5/04
Fertiliser: 150kg MAP/ha at sowing.
Row Spacing: 25cm
Paddock History:
2004 – Wheat
2003 – Canola
2002 – Wheat for hay
Plot Size: 60m x 6.1m
Replicates: nil

Key message:

- Controlling stripe rust with applications of fungicide may not always increase profitability.

Aim:
To assess whether the application of a foliar fungicide would prevent yield loss due to stripe rust in an irrigated wheat crop.

Method:
Wheat (Chara) was sown into irrigated bays. When stripe rust infection levels escalated to 1% of leaf area during spring, the grower applied a fungicide with a propiconazole/cyproconazole mix. A nil treatment section was left alongside the treated section for comparison.

Harvest took place on 18th January 2004 and yield was measured using a weigh bin.

Results:

Table 12: Harvest grain sample results

Plot	Treatment	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hl)
Chara	No Fungicide	6.90	12.1	2.5	78.8
Chara	With Fungicide	6.61	12.4	2.4	83.1

Observations and comments:
In the absence of replicated trials, a direct comparison is made between the treated and non-treated bays. The nil fungicide treatment yielded approximately 330kg/ha more than the treated plot. This result could possibly be due to several factors including: uneven infection across the paddock, variations in paddock fertility and crop knockdown due to wheel tracks made when applying fungicide via a ground rig.

While protein and screenings levels across the two blocks were similar, test weights varied, with the nil fungicide treatment having a lower test weight. Stripe rust ceased to develop in either bay post spraying, so these differences are difficult to explain.

Sponsors: Farmer co-operator; Craig Reynolds.

Leaf Bleaching - Is Copper or Calcium deficiency the cause?

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Barooga, NSW
Growing Season Rainfall:
Annual: 325mm
GSR: (Apr-Nov) 271mm
Soil: Type: Clay loam
pH ($H_2 0$): 5.5
Sowing Information:
Sowing date: 26/04/04
Row Spacing: 12 inch
Paddock History:
2004 – Wheat
2003 – Canola
2002 - Wheat
Plot Size: Bays
Replicates: nil

Key messages:

- Bleaching can be symptomatic of copper or calcium deficiency, but crops seem to grow out of it.
- Foliar application of trace elements at late tillering in this trial failed to increased yield.

Aim:
To investigate the effect of applying trace elements to prevent yield loss when visual symptoms and leaf analysis suggested copper and/or calcium deficiency in wheat.

Method:
There were 4 treatments of irrigated Chara wheat, which received either a foliar application of copper (Cu), calcium (Ca), copper & calcium or nil treatment. Crop was sown on 26th April with Cu also applied as $CuSO_4$ at sowing. Yield was determined using the growers yield monitor.

Results:
Symptoms suggesting a possible Cu or Ca deficiency became evident at mid tillering with mid leaf bleaching and pigtailing. Affected leaves were sampled 9/8/04, with analysis indicating Ca was very low at 0.08% (Ca is considered marginal at <0.18%) and that Cu was low at 3 ppm (deficient at <2 ppm).

Table 13: Barooga leaf analysis results for various treatments *

	Ca Treat.	Cu Treat.	Nil Treat.	Cu+Ca Treat.	Comments
Application rate	400g/ha Ca	250g/ha Cu	0	400g/ha Ca + 250g/ha Cu	Sprayed 23/9/04
YEB - Ca status (%)	0.375	0.337	0.309	0.341	Marginal at <0.18
YEB - Cu status (mg/kg)	5.4	5.64	5.34	6	Deficient at <2
Yield t/ha	**6.96**	**7.12**	**7.46**	**6.89**	

*unreplicated, # YEB = Youngest emerged blade

Observations and comments:
As Cu & Ca are not readily mobile within the plant, testing of the flag leaf should indicate deficiency. However, Youngest Emerged Blade (YEB) analysis in October indicated that Cu and Ca levels were adequate for this stage of growth and that there was negligible difference in the Cu and Ca status of flag leaves 3 weeks after spraying across all treatments. Symptoms were present to the same degree in all plots.

The highest yielding plot was the nil treatment, followed by the Cu, the Ca, and the Cu + Ca treatments. There was a difference in harvest dates due to high grain moisture in the Nil treat & Cu + Ca plots. The absence of wheel tracks may also have contributed to the higher yields in the nil treatment plot.

The two separate leaf tests were contrary to each other, but not necessarily inaccurate. This most likely suggests Ca or possible Cu deficiency in some leaves induced by unknown soil/environmental effects, which the crop was then able to grow out of.

Sponsors: Bacton Pastoral Co.

Euroa Trace Elements Trial

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Euroa
Growing Season Rainfall:
Annual: 455mm
GSR: (Apr-Nov) 433mm
Soil:
Type: Grey Clay loam
pH (H_20): 5.6
Sowing Information:
Sowing date: 11/06/04
Fertiliser: 110kg DAP/ha at sowing
Row Spacing: 25cm
Paddock History:
2004 – Wheat
2003 – Wheat
2002 – Pasture
Plot Size: 140m x 7.6m
Replicates: nil

Key message:
- Copper applied pre-sowing as copper sulphate ($CuSO_4$) did not lift yields at Euroa during 2004.

Aim:
To investigate the effects of applying Cu on the yield of wheat.

Method:
The paddock received an application of 3kg $CuSO_4$/ha onto bare soil on the 26/05/04. A 140m x 7.6m strip within the paddock received the same treatment, while another strip of the same size was left untreated. These strips were then harvested, with yield determined using a weigh-bin. Strips of the same size were also taken from a different treated and untreated area of the paddock.

Results:
A Youngest Emerged Blade (YEB) tissue analysis was done for each strip on 16/9/04. The results suggested that while the Cu concentration was lower (4.6 mg/kg) in the nil Cu treatment strip when compared to the Cu treated strip (6.4mg/kg), the result was above the recommended level of 2 mg/kg. The nil copper treatment indicated a low calcium concentration at 0.13% compared to 0.11% in the Cu treated strip. Other trace elements were either within, or just below, the optimal range suggested by the testing company.

Table 14: Comparison between Cu & untreated areas of Euroa paddock

	Cu Strip	No Cu Strip	No Cu (paddock)	With Cu (paddock)
Plant count (p/m^2)	162	160	185	-
Tiller count (t/m^2)	527	552	725	-
Head count (h/m^2)	475	473	388	-
Yield (t/ha)	6.6	6.6	6.22	6.69
Protein (%)	9.2	9.2	9.9	9.1
Screenings (%)	2.2	2.3	2.1	2.7

Observations and comments:
The lack of response to the applied Cu suggests that paddock levels of Cu were adequate in this instance. There were no physical symptoms of deficiency in either plot. Protein was the same in both plots and screenings were very similar. Head and tiller counts from the side by side strips were similar. However, the treatments were not replicated and cannot be statistically analysed.

The paddock results (last 2 columns of table) suggest a difference in yield, and slight differences in protein and screenings between the paddock treatments. Given that the paddock test strips were taken from different areas of the paddock, the difference in results needs to be considered with paddock variability in mind. Hence the plot strips provide the most robust data.

Sponsors: Farmer co-operator; Don Hunt.

Companion-cropping lucerne at Burraja

Author: Rob Harris

Contact No: 02 6030 4500

Organisation: DPI Victoria, Rutherglen

Location: Burraja
Growing Season Rainfall:
Annual: 506mm
GSR: 324mm
Soil:
Type: Red Chromosol
pH ($CaCl_2$): 5.5
Sowing Information:
Sowing date: 28/5/04
Fertiliser: 100kg DAP/ha
Paddock History:
2004 – Crop
2003 – Crop
2002 – Crop
Row Spacing: 17.5cm
Plot Size: 16.5m x 40m
Replicates: 3

Key messages:

- In addition to competition for water over the spring period, competition by lucerne over the winter period is also having an affect on crop production.

Aim:
To assess the effect of sowing wheat and barley into an established stand of lucerne on grain and lucerne DM production.

Method:
Wheat and barley crops were sown into a mature lucerne stand (sown in 1998) and compared with monoculture wheat, barley and lucerne in a replicated field experiment located at Burraja. Grain yields from the wheat and barley crops and lucerne dry matter over the growing season (April-October) were measured in 2002-2004.

Results:

Table 15: Crop and lucerne yields at Burraja from 2002 to 2004

Year	Crop	GSR (mm)	Crop grain yield (t/ha)			Lucerne DM yield[#] (t/ha)		
			Crop alone	Crop with lucerne	Yield reduction (%)	Lucerne alone	Lucerne with crop	Yield reduction (%)
2002	Wheat	150	0.6	0.1	-83	0.8	0.5	-38
	Barley	150	0.7	0.3	-57	0.8	0.3	-63
2003	Wheat	389	6.0	4.9	-18	3.7	1.3	-65
	Barley	389	5.2	5.2	0	3.7	1	-73
2004	Wheat	222	2.4	1.7	-29	2.5	0.5	-80
	Barley	222	2.4	2.1	-13	2.5	0.5	-80
Mean	**Wheat**	**324***	**3.0**	**2.2**	**-27**	**2.3**	**0.8**	**-65**
	Barley	**324***	**2.8**	**2.5**	**-11**	**2.3**	**0.6**	**-74**

[#]DM production measured from April to October only.
* 90 year average

Observations and comments:

Over the three years of the trial, wheat and barley crops growing with lucerne experienced average grain yield reductions of 27% and 11% respectively, compared with sole wheat and barley crops. In contrast the lucerne growing with wheat and barley crops was on average 65% and 74% respectively, less productive than the sole lucerne.

Barley consistently out-yielded wheat when sown into lucerne in all three years of the trial. This may have been due to barley having a shorter growing season compared with wheat and therefore experienced less competition from the lucerne for soil water during grain filling. In addition, in the 2003 the barley grown with lucerne lodged less than the sole barley.

Grain yield reductions were more severe in the 2002 drought when growing season rainfall was 174 mm below the long-term mean, while grain yield reductions were smallest in 2003 when growing season rainfall was 65 mm above the long-term mean. Thus the success of companion cropping is strongly dependent on seasonal rainfall.

Sponsors:

Cooperative Research Centre for Plant Based Management of Dryland Salinity,
Department of Primary Industries Victoria, and
The Grains Research and Development Corporation.

Companion-cropping lucerne at North Boorhaman

Author: Rob Harris

Contact No: 02 6030 4500

Organisation: DPI Victoria, Rutherglen

Location:
North Boorhaman
Growing Season Rainfall:
Annual: 541mm
GSR: 358mm
Soil:
Type: Red Sodosol
pH ($CaCl_2$): 6.4
Sowing Information:
Sowing date: 4/6/04
Fertiliser: 100kg DAP/ha
Paddock History:
2004 – Crop
2003 – Crop
2002 – Lucerne
Row Spacing: 7 inch
Plot Size: 8m x 6m
Replicates: 4

Key messages:

- We had expected that competition for water over the spring period would most likely limit grain production of the annual crops sown into lucerne. In addition, competition over the winter period is also having an affect on crop production in the presence of lucerne.
- Triticale grown with lucerne had a lower grain head density at crop flowering compared with sole triticale, suggesting that competition from lucerne over the winter period compromised tiller formation.

Aim:

To assess the effect of water supply on the production of annual crops sown into established lucerne.

Method:

In a replicated field experiment located at North Boorhaman, three dryland treatments (triticale sown into lucerne, sole triticale and sole lucerne) were compared with three equivalent treatments receiving sufficient irrigation water in spring to maintain plant available water (PAW) in the soil. Grain yields from the triticale crops and lucerne dry matter over the crop's growing season (April-October) were measured.

Results:

Table 16: Crop and lucerne yields at North Boorhaman

Crop	PAW (mm)	Crop grain yield (t/ha)			Lucerne DM yield# (t/ha)		
		Crop alone	Crop with lucerne	Yield reduction (%)	Lucerne alone	Lucerne with crop	Yield reduction (%)
Dryland triticale	319	3.4	2.3	-32	5.6	0.9	-84
Irrigated* triticale	403	4.8	3.7	-23	7.1	1.3	-82

PAW (Plant Available Water)
#DM production measured from April to November only.
* Additional 84 mm of irrigation was applied in October and November.

Table 17: Crop density at North Boorhaman

Treatment	Seedling density (plants/m^2)	Head density (heads/m^2)
Triticale#	101	196
Triticale with lucerne#	96	162

#Mean of dryland and irrigated treatments.

Observations and comments:
Where no irrigation water was applied, triticale sown into lucerne yielded 32% less grain than triticale alone, while irrigated triticale growing with lucerne yielded 23% less grain than the irrigated triticale alone. In contrast the dryland and irrigated lucerne growing with triticale produced 84% and 82% less dry matter, respectively, over the growing season than their respective dryland and irrigated sole lucerne treatments (see Table 16).

Initially we had thought that competition for water over the spring period was the main constraint to grain production where annual crops are sown into lucerne. However, the yield data from Table 16 suggests that competition occurring earlier in the growing season is also having an affect on crop production in the presence of lucerne. This conclusion is supported by data presented Table 17, where triticale growing with lucerne had a lower head density at crop flowering, suggesting that competition from lucerne over the winter period had compromised tiller formation. Future research needs to assess the potential of additional top-dressed nitrogen to promote more tillering in crops growing with lucerne.

Sponsors:
Cooperative Research Centre for Plant Based Management of Dryland Salinity,
Department of Primary Industries Victoria, and
The Grains Research and Development Corporation.

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Companion-cropping lucerne for winter feed at North Boorhaman

Author: Rob Harris

Contact No: 02 6030 4500

Organisation: DPI Victoria, Rutherglen

Location:
North Boorhaman
Growing Season Rainfall:
Annual: 541mm
GSR: 358mm
Soil:
Type: Red Sodosol
pH ($CaCl_2$): 6.4
Sowing Information:
Sowing date: 4/6/04
Fertiliser: 100kg DAP/ha
Paddock History:
2004 – Crop
2003 – Crop
2002 – Lucerne
Row Spacing: 7 inch
Plot Size: 8m x 6m
Replicates: 4

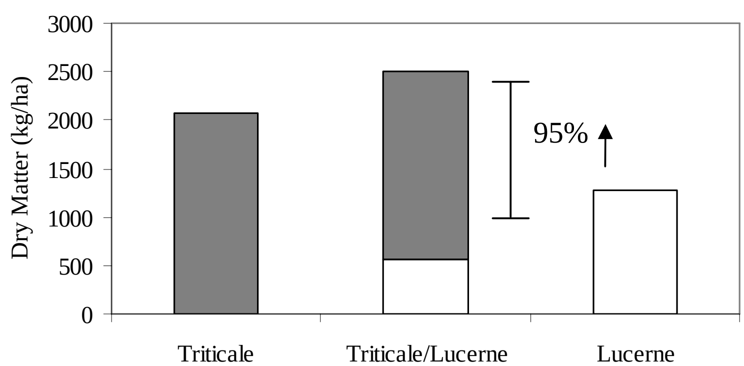
Key messages:

- Sowing triticale into two-year-old lucerne produced an extra 1221 kg/ha of dry matter over the winter period compared with lucerne alone.
- Sowing forage and dual-purpose cereals into mature lucerne stands may be one strategy to increase feed supply from lucerne pastures over the winter.

Aim:
To assess the potential of cropping lucerne pastures to increase winter dry matter production.

Method:
In a replicated field experiment at North Boorhaman three treatments were established; triticale sown into lucerne alone, triticale and lucerne alone. Lucerne and triticale dry matter production was measured $14^1/_2$ weeks after the triticale was sown on the 4th of June.

Results:



Bar represents least significant difference

Figure 19. Dry matter production measured for the period 4th June – 14th September 2004

Observations and comments:
Sowing triticale into a two-year-old lucerne stand resulted in an extra 1221 kg/ha of total dry matter over the winter period compared with the lucerne alone (see Figure 19). Lucerne pastures are largely dormant over the winter period, producing very little dry matter at a time when feed for livestock is often in short supply. Cropping into mature lucerne may be one approach to increase feed supply at this crucial time of the year. Further research is planned to evaluate the effectiveness of dual-purpose and forage cereals for delivering additional winter-feed from lucerne pastures.

Sponsors:
Cooperative Research Centre for Plant Based Management of Dryland Salinity,
Department of Primary Industries Victoria, and
The Grains Research and Development Corporation.

Picola/Nathalia District Urea Amonium Nitrate Trial

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Nathalia district
Growing Season Rainfall:
Annual: 330mm
GSR: (Apr-Nov) 296mm
Soil:
Type: Self mulching grey clay
pH (H_20): 5.5
Sowing Information:
Sowing date: 03/06/04
Fertiliser: 85kg MAP/ha at sowing
Row Spacing: 25cm
Paddock History:
2004 – Wheat
2003 – Canola
2002 – Barley
Plot Size: 90m x 9.1m
Replicates: 4

Key message:

- A double dose of Urea Amonium Nitrate (UAN) was taken up at 32% efficiency and increased grain yield by 12%.

Aim:
To observe the response of wheat to a double rate of UAN liquid fertiliser versus a UAN 60L/ha control.

Method:
Wheat (Chara) was sown in 90m x 9.1m strips using the farmer's air seeder as part of a larger trial. Seeding rate was 85 kg/ha. UAN was applied 7/8/04 (Z 29) at 60L/ha across all plots. An additional 60L of UAN (Total 120L UAN/ha) was applied in a 28 metre strip across the southern end of plots on the same day. Yield was determined using the farmer's header and yield monitor.

Results:

Table 18: Results of Picola/Nathalia district UAN trial 2004

	UAN applied 1xrate 60L/ha			UAN applied 2xrate 120l/ha					% yield increase UAN
	Yield (t/ha)	**Protein (%)**	**Nitrogen uptake (kg/ha)**	**Yield (t/ha)**	**Protein (%)**	**Screenings (%)**	**Test weight (kg/hl)**	**Nitrogen uptake (kg/ha)**	
Chara 1	3.37	8.3	45	3.65	10.5	1.3	77.0	61	7
Chara 2	3.07	9.1	45	3.77	9.4	0.9	79.7	57	19
Chara 3	3.17	9.0	46	3.73	8.6	0.7	79.8	51	15
Chara 4	3.27	8.8	46	3.54	8.6	0.8	78.2	48	7
Average	**3.22**	**8.8**	**45.5**	**3.67**	**9.27**	**0.93**	**78.7**	**54.25**	**12**

Observations and comments:
Late but reasonable winter rainfall meant that the plot site experienced little stress until October when the dry conditions caused plots to exhibit symptoms of moderate-severe moisture stress.

The 2x rate (120L) application appears to have increased yields of Chara by 7-19% over the single application rate (60L). The protein response was more variable, with 2 plots responding positively and 2 plots responding negatively for changes in protein. Test weights and screenings were similar across both treatments. Each replicate was spatially separated by a distance of 18m, so paddock variability could have influenced results.

When N uptake was calculated, 32% of the extra 60 L/ha N applied was taken up into the grain to increase yield and/or protein.

Sponsors: Farmer co-operator; Murray Gilby.

Wheat Cultivar and Nitrogen Management Trials – Congupna

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Congupna
Growing Season Rainfall:
Annual: 375mm
GSR: (Apr-Nov) 317mm
Soil:
Type: Grey Clay loam
pH (H_20): 5.8
Sowing Information:
Sowing date: 30/5/04
Fertiliser: 150kg MAP/ha at sowing, 100kg/ha urea topdressed in Sept.
Row Spacing: 25cm
Paddock History:
2004 – Wheat
2003 – Canola
2002 – Wheat for hay
Plot Size: 60m x 6.1m
Replicates: nil

Key messages:
- Use strategic N applications to lift protein in high yielding crops.
- Chara, Drysdale and Rubric yielded similarly in this variety trial.

Aims:
- To assess yield potential of different irrigated wheat varieties in the Congupna region.
- To assess how a nitrogen application in late September would affect grain yield and quality.

Method:
Wheat (Chara, Drysdale and Rubric) were sown in separate irrigation bays on the 30th May at a rate of 100 kg/ha. Urea (100kg/ha) was then applied in a 12m wide strip to the Chara and Rubric bay on the 27th September. Harvest took place on 18th January 2004 and yield was measured using a weigh bin. The crop was pre-irrigated and had 2 spring waterings.

Results:

Table 19: Harvest grain sample results

Variety	N treat	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hl)	Nitrogen Uptake (kg/ha)
Chara	nil	6.49*	12.3	1.4	81.5	128
Chara	+ 46kgN/ha	6.97	12.9	2.1	83.5	144
Drysdale	nil	6.79	10.1	2.3	82.5	110
Rubric	nil	6.78	10.9	1.2	82.4	118
Rubric	+ 46kgN/ha	7.00	12.0	1.0	83.4	134

* High densities of ryegrass may have reduced yields in this treatment

Observations and comments:
The treatments were unreplicated, so yield variations may be due to a combination of varietal characteristics and/or paddock variability.

Varieties Rubric and Drysdale yielded similarly (6.78-6.79 t/ha) in the absence of N while Chara yielded slightly less (6.49 t/ha). Chara had the highest protein at 12.3%, while Rubric and Drysdale were both in the 10-11% range. Screenings were low in all varieties.

The urea top-dressed in late September appeared to have a varied effect on yield and quality. The additional N appeared to lift Chara's yield by 0.5t/ha (or 7%), and increased yields in Rubric by 0.2 t/ha (or 3%). When Nitrogen uptake is calculated across the treatments, we can see that the Chara and Rubric each took up 35% of the 46kg N/ha applied, and that this was used to variably increase yield and/or protein.

Sponsors: Farmer co-operator; Craig Reynolds.

Picola/Nathalia District Wheat Trials

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Nathalia district
Growing Season Rainfall:
Annual: 330mm
GSR: (Apr-Nov) 296mm
Soil: Type: Self mulching grey clay
pH (H_20): 5.5
Sowing Information:
Sowing date: Chara 03/06/04, other varieties 06/06/04
Fertiliser: 85kg MAP/ha at sowing
Paddock History:
2004 – Wheat
2003 – Canola
2002 – Barley
Row Spacing: 25cm
Plot Size: 90m x 9.1m
Replicates: 4

Key message:

- Chara and Whistler wheat continue to perform well in the Picola/Nathalia region.

Aim:
To test several wheat varieties to determine their suitability for the Picola /Nathalia district.

Method:
Wheat varieties were sown in 65m x 9.1m strips using the farmer's air seeder. Seeding rate was 85 kg/ha, except for the larger sized Yitpi, which was sown at 120 kg/ha. Seed was sown with 85 kg MAP/ha. Urea Amonium Nitrate (UAN) was applied on 7/8/04 (Z 29) at 60L/ha. A Tebuconazole fungicide was applied to control stripe rust.

Results:

Table 20: Results of Picola/Nathalia district wheat trial 2004

Variety	t/ha	Protein	Screenings	Test weight
Whistler	3.47	8.3	0.9	77.4
Chara	3.37	8.3	0.8	77.7
Chara	3.27	8.8	0.8	75.5
Chara Average	3.22	8.8	0.85	77.1
Chara	3.17	9.0	0.8	75.5
Diamondbird	3.14	9.1	0.8	78.3
Chara	3.07	9.1	1.0	79.7
H45	3.05	8.5	0.8	76.5
Annuello	3.05	10.0	3.0	80.4
Drysdale	2.98	8.8	0.9	78.7
Yitpi	2.88	9.5	0.8	76.5
EGA Wedgetail	2.88	9.1	0.4	77.2
LSD	0.46	0.4	0.11	7.2

Observations and comments:
Late, but reasonable winter rainfall meant that the plot site experienced little stress until October when the extended dry period caused plots to exhibit symptoms of moderate-severe moisture stress.

Despite the late start and dry finish, the longer season varieties Whistler and Chara performed the best, which replicates the results of 2003 where Whistler and Chara were the two top performing varieties. It is possible that sizeable rainfalls in early November may have helped longer season varieties such as Chara and Whistler, although Wedgetail, also a long season variety, didn't benefit to the same extent. Protein was generally low due to the dry season and the conservative approach to nitrogen management. Screenings were generally low and test weights were reasonably similar across the plots.

Sponsors: Farmer co-operator; Murray Gilby.

Cereal Variety and Urea Trial - Boorhaman

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Boorhaman
Growing Season Rainfall:
Annual: 426mm
GSR: (Apr-Nov) 358mm
Soil: Type: Red duplex
pH (H_2O): 5.8
Sowing Information:
Sowing date: 30/5/04
Fertiliser: 100kg DAP at sowing, topdressed with 90kg Urea
Row Spacing: 7 inch
Paddock History:
2004 – Wheat
2003 – Triticale
2002 - Wheat
Plot Size: 60m x 6.1m
Replicates: Nil

Key message:
- Ensure Nitrogen (N) is in adequate supply to achieve targets for yield and protein.

Aim:
To assess the effect of applying urea in spring on the performance of several wheat varieties in the Boorhaman area.

Method:
Wheat varieties were sown in large plots at a rate of 85kg/ha into good moisture. Fertiliser (DAP 100kg/ha) was applied at sowing and 90kg/ha of urea was topdressed on the 18th September. Harvest took place on 18th January 2004 and yield was measured using a weigh bin.

Results:

Table 21: Harvest grain sample results

Variety	Yield (t/ha)	Protein (%)	Screenings (%)	Test Weight (kg/hl)
Diamondbird	4.39	8.2	3.9	76.6
Bowerbird	4.9	9	6.6	70.4
Wylah	5.71	8.6	5.4	71.2
Chara	4.6	8.5	5.6	72.5
Drysdale	4.7	7.9	3.1	76.8
Wedgetail	3.99	9.0	4.1	75.1
Whistler	4.02	9.1	2.4	76.7

Table 22: Topdressing trial results

Region	Treatment	Yield t/ha	Protein %	Screenings %	Test Weight (kg/hl)	N grain uptake (kg/ha)
Boorhaman	+ N strip	5.2	7.9	5.0	75.3	65.7
Boorhaman	- N Strip	4.89	7.6	2.8	79	59.5

Observations and comments:
The variety treatments were grown on a site with considerable variation in soil type. The varieties grown on the lighter soil yielded less than those on the heavier soil. The results may therefore not reflect the true yield potential in this environment.

Protein was low for all varieties and is indicative of low N availability. The dry season was a factor, with N management approached conservatively. Screenings tended to decrease in the plots closest to the rise, suggesting that grain fill was more affected in the lower areas of the paddock where growth was most vigorous.

The spring N application increased yield by 0.3t/ha compared to the untreated area. Protein was similar across treatments, however screenings were higher where N was topdressed. Test weights also varied, with the spring N treatment having a lower test weight. An N uptake calculation between the two treatments showed that 15% of the added N was uptaken into the grain.

Sponsors: Farmer co-operator; Damian O'Keefe.

Pea Variety Demonstration - Nathalia

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Nathalia district
Growing Season Rainfall:
Annual: 240mm
GSR: (Apr-Nov) 193mm
Soil:
Type: Clay loam
pH (H_20): 5.3
Sowing Information:
Sowing date: 11/06/04
Fertiliser: 125kg Single Super/ha at sowing.
Paddock History:
2004 – Peas
2003 – Wheat
2002 – Canola
Row Spacing: 25cm
Plot Size: 60m x 8.2m
Replicates: nil

Key messages:
- Kaspa has outyielded Excell in the past two seasons at Picola.
- Kaspa's sugar pod trait reduces losses due to shattering.

Aim:
To evaluate the performance of the recently released field pea variety Kaspa against Excell.

Method:
Seed was inoculated and the following day sown into good moisture in mid June, with 125 kg/ha single super. Kaspa and Excell were both sown as 60m x 8.2m plots using the grower's International 911 combine. Seed was sown at 120 kg/ha. Seed was hand harvested from 4 x 1.2m^2 plots within each variety and machine threshed and weighed on a scale.

Results:

Table 23: **Results of Nathalia pea trial 2004**

Variety	Yield t/ha	Plant density plants/m^2	Seed Weight /1000 seeds (g)	% of Excell 2004	% of Excell 2003
Kaspa	0.9	51	172	134%	125%
Excell	0.6	32	219	100%	100%

Observations and comments:
The site incurred a number of stresses this season. Significant September rains caused an unexpected germination of wild oats throughout the site, which severely out-competed the peas, reducing pea plant numbers and density.

A frost around the 19th October damaged pods of both varieties, although the Kaspa seemed to be slightly more affected. The lack of October rain further reduced the yield of both varieties. The crop was aerially sprayed twice with insecticide to control heliothis.

A visual inspection in mid October suggested that the earlier flowering Excell had a greater number of pods and were more advanced than the Kaspa. However, the greater pod set did not translate into increased yield. These results are similar to those of a 2003 trial in the same region, where Kaspa yielded 25% more than Excell. The Excell seed size (219g/1000 seeds) was larger than that of Kaspa's (172g/1000 seeds), however late rains affected the Excell quality, with approximately 50% grains affected by bleaching. Shattering was more pronounced in the Excell compared to Kaspa, which is most likely due to Kaspa's sugar pod trait which holds the pod together as it matures.

Due to the poor growing season, the grower decided not to proceed with mechanical harvesting, instead opting to graze the paddock out.

Sponsors: Farmer co-operator; Mackenzie Craig.

Euroa Seeding Rate trial

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Euroa
Growing Season Rainfall:
Annual: 455mm
GSR: (Apr-Nov) 347mm
Soil:
Type Grey Clay loam
pH (H_20): 5.6
Sowing Information:
Sowing date: 11/06/04
Fertiliser: 110kg DAP/ha at sowing
Paddock History:
2004 – Wheat
2003 – Wheat
2002 – Pasture
Plot Size: 168m x 7.6m
Replicates: nil

Key message:
- Changing seeding rate did not have any affect on wheat yield at Euroa during 2004.

Aim:
To investigate whether increasing or decreasing sowing rates could increase wheat yields in the Euroa district during 2004.

Method:
Wheat (Chara) was sown in 140m x 7.6m strips at one of 3 sowing rates: a high rate of 115kg/ha, a medium rate of 77 kg/ha, and a low rate of 54 kg/ha. All were sown with 110kg DAP/ha, which was also treated with a Flutriafol fungicide (in furrow). Yield was determined using a weigh bin.

Results:

Table 24: **Differences between sowing treatments at Euroa**

Treatment	Low Seed rate	Mid Seed rate	High Seed rate
Plant count (p/m^2) (3/9/04)	112	173	255
Tiller count (t/m^2) (3/9/04)	400	639	742
Head count (h/m^2) (2/12/04)	355	431	457
Yield (t/ha)	6.44	6.41	6.33
Protein (%)	9.6	9.6	9.6
Screenings (%)	2.4	2.2	2.1

Observations and comments:
There was little yield difference between the three seeding rate trials. The highest sowing rate had the highest level of tiller mortality at 49%, whilst the medium rate had a tiller mortality of 33% and the low sowing rate had a mortality of just 12%. Interestingly while the medium and high rates had more heads/m^2 in early December, they yielded almost identically to the low seeding rate.

While there was only a slight yield difference between the treatments, we can theorise that the dry finish may have penalised the high sowing rate due to increased competition for resources, and this theory also explains the dramatic drop off in tiller numbers. Conversely, this also explains why the low seeding rate may have performed well.

The plots were unreplicated, so we cannot attribute the response (or lack of) to seeding rate alone. However, we can say that at this particular site, in a year with a dry finish, a lower sowing rate of 54 kg/ha appeared to yield as well as a standard sowing rate of around 80 kg/ha. It is difficult to draw specific conclusions about the benefits/disadvantages of either high or low rates from this trial, but the trial does once again highlight the compensatory ability of wheat.

Sponsors: Farmer co-operator; Don Hunt.

Deep N Soil Sampling

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Various
Growing Season Rainfall:
Avg: 240-350mm (Apr-Nov)
2004: 193-433mm
Soil: Various
Sowing Date: Various
Paddock History: Various

Key Message:
- A soil test provides a very useful basis for decisions when it comes to nitrogen (N) budgeting in a variable season.

Aim:
To assess yield and protein results of several farmer sites and compare this to soil sampling results collected just after sowing.

Method:
Cores (0-60 cm) were taken in early-mid June and were then analysed for ammonium (NH_4^+) and nitrate (NO_3^-) content. Soil results were then compared to protein and yield results.

Results:

Table 25: **Harvest grain sample results**

Location	Rotation		Avail N kg/ha (0-60 cm)	Sowing date	Topped N	Target Yield (t/ha)	Yield (t/ha)	Protein (%)	Grain N uptake (kg/ha)
Congupna 1	Can/Wht	Irrig	235	29-May	nil	7.1	6.49	12.3	127
Congupna 2	Wht/Bar	Irrig	210	5-May	nil	7.4	6.0	11.2	108
Katamatite 1	Sub/Wht	Irrig	176	29-May	37	6.6	4.9	11.3	89
Picola 1	Wht/Wht	Irrig	126	28-May	nil	4.15	4.0	10.5	67
Congupna 3	Soy/Oat hay	Irrig	92	10-June	37	9.4	10.0	5.8	93
Katamatite 2	Luc/Wht	Irrig	76	28-May	37	4.1	5.05	12.2	99
Boorhaman	Trit/Wht	Dry	92	30-May	nil	3.3	3.81	8.0	49
Picola 2	Can/Wht	Dry	84	3-June	nil	2.9	2.7	9.0	39
Picola 3	Can/Wht	Dry	76	17-May	nil	2.7	1.1	11	19
Picola 4	Bar/Wht	Dry	59	29-May	nil	2.2	1.8	9.0	26

Can – Canola Wht – Wheat Bar – Barley Sub – Sub Clover Soy – Soy bean Dry – Dryland
Irrig – Irrigation Luc – Lucerne

Observations and comments:
Given the low growing season rainfall many of the dry land paddocks were not top dressed. At the time these decisions were being made, the soil test results gave confidence that low target yields could be made with no additional N. The target yields in Table 25 are limited by nitrogen at sowing + fertiliser + mineralisation, irrespective of rainfall. The irrigated paddocks had varying soil tests, but the results of the two top paddocks meant that topdressing was not required. The nitrogen removal from most paddocks suggests a less than 50% uptake of soil N if some estimate of mineralisation is included.

Two paddocks of contrast are Katamatite 1 and 2, which both come off a paddock history of sub clover or lucerne hay making. The sub paddock had supposedly enough nitrogen to yield much greater but didn't. The lucerne paddock should have yielded less but yielded more. An explanation for this may lie with the sub paddock mineralising less N during the season due to its rapid breakdown after the opening rains. The lucerne however may have mineralised much more in the presence of irrigation. In the end both crops yielded similarly. The Boorhaman paddock was conservatively set up to yield 3 t/ha but late spring rain increased the yield potential. However, it was too late to topdress and hence the protein was lowered. The Congupna hay paddock is difficult to fathom with N removed in hay similar to that provided by the soil. The mineralisation for the season and the top dressed N cannot be accounted for, the low protein of the hay was in some part due to very late cutting with some mature grain.

Acknowledgments:
Thanks to all growers for allowing us onto their paddocks for testing after sowing.

Insert ABB Ad

Pulse Demonstration - Boorhaman

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Boorhaman
Growing Season Rainfall:
Annual: 426mm
GSR: (Apr-Nov) 358mm
Soil:
Type Red duplex
pH (H_20): 5.8
Sowing Information:
Sowing date: 30/5/04
Fertiliser: 100kg DAP at sowing, topdressed with 90kg Urea
Row Spacing: 7 inch
Paddock History:
2004 – Wheat
2003 – Triticale
2002 - Wheat
Plot Size: Peas 0.14 ha, Faba Beans 0.18ha

Key messages:
- Ensure machinery is set up correctly for all pulse sowing and harvesting operations.
- Harvest peas on time to prevent shattering losses.

Aim:
To assess the yield potential of faba beans and field peas in the Boorhaman region.

Method:
Fiesta faba beans were sown over an area of 0.28 ha on the 30th May and at a rate of 140kg/ha into good moisture. Excell peas (0.14ha) were sown at 150 kg/ha on the same date, in an area adjacent to the faba beans. Harvest took place on 18th January, 2004 and yield was measured using a weigh bin.

Results:

Table 26: **Harvest grain sample results**

Crop	Yield (t/ha)	Plant counts (plants/m^2)
Field Peas - Excell	0.89	45
Faba Beans - Fiesta	1.76	18

Observations and comments:
Diseases (chocolate spot etc) were present at very low levels. Fungicides were not applied to the faba beans during the season, with the drier conditions preventing disease build-up. Heliothis or pea weevils did not significantly damage the field peas.

Given the growing season rainfall of 358mm, the expected faba bean yield was in the order of 2.9 t/ha. However actual yield was 1.76t/ha. This failure could have been caused by:
- Sowing rate and depth (uneven sowing rate with excessively shallow seed placement)
- Early duck damage to faba beans (which severely checked plant growth)
- Moisture stress due to the drier than average season (decile 2-4).

Expected field pea yield was in the order of 3.1 t/ha, which was very different from the actual yield of 0.89 t/ha. Possible reasons for this include:
- Uneven sowing rate
- Red Legged Earth Mite introgression from the fenceline, affecting establishment
- Late harvest (12/01/05), which led to shattering losses both before and during harvest.

Conclusion:
Faba beans and field peas remain a good option for the North East. The failures in this trial serve to highlight the importance of sound pulse agronomy, with machinery set-up, pest control and timing of all operations, particularly harvest, impacting on the success of the crop.

Sponsors: Farmer co-operator; Damian O'Keefe.

NE Tissue testing results

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Key Message:
- Of the paddocks tested there were few nutritional problems in 2005.

Aim:
The aim was to undertake tissue testing to assess the nutritional status of several crops in north east of Victoria.

Method:
Nine cereal paddocks were tested for nutrient status using youngest emerged blades (YEB) analysis and whole shoot analysis. Samples were taken at varying stages of crop development.

Results:

Table 27: Results of YEB paddock tissue tests conducted by Cobram DPI 2004

	Crop type	Date Sampled	Growth stage	Calcium (%)	Magnesium (%)	Copper (mg/kg)	Zinc (mg/kg)	Boron (mg/kg)	Moly (µg/kg)
Picola 1	Wheat	20/10/04	Early Milk	0.296	0.18	6.96	13.05	7.99	373
Boorhaman	Wheat	21/10/04	Flowering	0.31	0.14	6.75	13	3.05	701
Katamatite (lucerne 03)	Wheat	8/10/04	Awn Peep	0.267	0.17	5.61	16.71	6.59	379
Katamatite Sub (03)	Wheat	8/10/04	Awn Peep	0.32	0.21	6.02	15.27	20.7	308
Picola 2	Wheat	11/10/04	Flowering	0.34	0.25	5.26	18.8	8.49	345
Congupna	Wheat	29/10/04	Flowering	0.43	0.22	3.89	19.28	7.42	325
Barooga	Wheat	6/10/04	Flowering	0.309	0.189	5.34	21.44	10.3	516
Yarrawonga	Wheat	21/10/04	Early Milk	0.41	0.26	4.46	8.18	37.60	448
St James	Triticale	28/10/04	Early Milk	0.735	0.196	4.89	12.63	5.64	501
Minimum recommended result				Marginal <0.18	Marginal <0.15 (US data)	Deficient <2	Approx 7	Deficient <2,	Marginal <100

Table 28: Results of whole shoot tissue analysis in wheat undertaken by Cobram DPI 2004

Whole Shoot Analysis		**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**	**Sulfur (%)**	**Calcium (%)**	**Magnesium (%)**
Congupna	Control	1.83	0.19	2.07	0.21	0.18	0.13
Congupna	High Nitrogen	1.99	0.20	2.16	0.22	0.18	0.13
Yarrawonga	Paddock	1.19	0.15	1.71	0.12	0.12	0.2
Minimum recommended result		Deficient <1.47	Adequate ≥0.15-0.3≤	Adequate ≥1.5-2.5≤	Low <0.15 (US data)	Marginal <0.2 (US data)	Marginal <0.15 (US data)

Observations and comments:

YEB analysis

Despite visual mid leaf necrosis/pigtailing symptoms at Barooga and Picola, tissue tests indicated no deficiencies in copper or calcium at any of the sites tested and both these crops grew out of their symptoms. Magnesium levels were identified as being low at Boorhaman but were at normal levels elsewhere. Zinc was low at the Yarrawonga paddock, while boron was normal at all sites except Boorhaman. Molybdenum concentrations ranged from 300-700 μg/kg, and were more than adequate at all sites. The paddocks tested showed few nutritional problems of concern.

Whole Shoot analysis

Tissue tests indicate the Yarrawonga site was Nitrogen deficient as well as being marginal for Phosphorus, Potassium, Sulfur and Calcium. This dryland crop was severely moisture stressed when tested.

Acknowledgments:

Thanks to the growers for allowing us into their paddocks.

Insert IK Caldwell Ad

State Focus 2004 Boorhaman

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5872 0600

Organisation: DPI Victoria, Cobram

Location: Boorhaman
Growing Season Rainfall:
Avg: 370mm
2004 (Apr-Nov): 358mm
Soil:
Type: Red duplex
pH (Ca): 4.7
Sowing Information:
Sowing date: 26/5/04
Paddock History:
2003 – Wheat
2002 – Lupins
2001 – Wheat

Key Message:

- Cutting hay can be a successful way of reducing the ryegrass seed bank.

Aim:
To monitor weed seed banks and to observe the changes due to various weed control strategies.

Method:
Weed seed bank tests were conducted before the break and weed counts done throughout the growing season. The paddock selected was a commercial crop of oats (Dolphin).

Results:

- Ryegrass seed germination counts conducted before sowing showed a very large ryegrass seed bank of 16,500/m^2.
- After burning the stubble a knockdown and pre-emergent mix was applied followed by an early post emergent herbicide in crop.
- At emergence there were 120 oat plants/m^2. Table 29 shows the progression of the weed bank throughout the season.

Table 29: Calendar of actions and observations

Date and Action	Count/m^2
8th May pre sowing seed bank test	16,500 ryegrass /m^2
22nd May sprayed groups M C & K spray	
26th May sowed 80 kg/ha oats 100 kg/ha DAP	
23rd June ryegrass plant counts	670 ryegrass /m^2
2nd July sprayed group B herbicide	
12th August ryegrass plant count	444 ryegrass /m^2
21st October ryegrass plant count	178 ryegrass /m^2
25th October small area baled for hay	
10th December seed sampled for resistance testing	
23rd December grain harvest	2683 ryegrass seeds/kg
15th January post harvest seed bank test	Oats grain 8625 ryegrass /m^2 Oats hay 345 ryegrass /m^2

The burning + herbicides gave 97% control of the ryegrass bank which is excellent. The very large initial weed burden enabled enough ryegrass to get through to set seed, leaving a net 48% reduction in the seed bank for the coming season. Interestingly an area cut for hay resulted in a net 98% reduction of the seed bank for the year. Cutting hay compared to harvesting for grain, reduced the seed bank to manageable numbers.

Insert Case Ad

RESEARCH RELEVANT TO THE RIVERINE PLAINS

New annual legume cultivars, - where do they fit?

Authors: B.S. Dear, B.F. Hackney, G.M. Dyce and C.A. Rodham.

Contact No: 02 6938 1999

Company: NSW DPI, Agricultural Institute, Wagga Wagga

Abstract:
Four new sub clover cultivars (Izmir, Urana, Coolamon, and Napier) that are major improvements over the older cultivars they replace become commercially available in 2005 and 2006. The new cultivars have been developed by the National Annual Pasture Legume Improvement Program (NAPLIP). Other important recent releases by NAPLIP include the annual legumes Mauro biserrula and Erica and Margurita French serradella which are aerial seeding legumes that can be harvested on-farm using conventional headers to reduce seed costs.

Izmir
This new very early maturing cultivar was selected primarily for the West Australian low rainfall wheat belt. It flowers about 100-110 days after a mid May sowing with a maturity similar to Nungarin. It has higher levels of hard seed than Nungarin and is intended to be used in rotations with wheat. The objective is for the high hard seed levels to carry over seed between crops and allow regeneration without resowing. These short-phased farming systems are not common in eastern Australia and at this stage no obvious role has been identified for this cultivar in the eastern Australian wheat belt. Nungarin and Dalkeith continue to be preferred for most low rainfall wheat belt country although Izmir may be better suited to lower rainfall wheatbelt country where frequent false breaks require higher levels of hard seed.

Urana
This early maturing low oestrogen cultivar was released to replace the older cultivar Daliak, which although highly persistent, was unpopular because of its compact prostrate growth habit which made it appear less productive. Urana overcomes these limitations being a more erect cultivar with higher levels of hard seed to withstand false breaks. It has excellent seedling vigour in autumn with larger leaves than other cultivars in autumn. The hard seed level in autumn is about 31% which is higher than Seaton Park at 20%. Although susceptible to clover scorch disease and root rot these should not be a serious problem in areas where it is recommended for growing. It has slightly better resistance to RLEM than existing cultivars.

It is more productive than other early cultivars with herbage production averaging 14% higher than Dalkeith. It has very good seedling vigour and grows strongly in autumn. It has no leaf markings which make it easily distinguishable from most other cultivars.

Urana is suitable for regions with a shorter growing season in the lower rainfall areas of the wheat belt or lower rainfall tableland areas that receive an average annual rainfall of between 400 and 480 mm.

There is some anecdotal evidence that Urana may be more sensitive to some broadleaf herbicides but this is yet to be confirmed experimentally.

Coolamon
This mid season cultivar was bred as more erect and productive replacement for Junee. It produced on average 12% more autumn-winter feed and 16% more spring feed than Junee. In some environments it was up to 30% more productive than Junee. It has lower oestrogen levels than Woogenellup and Seaton Park.

It has a more erect growth habit than Junee and shows less dark pigmentation than Junee in winter. Another advantage is an increase in resistance to race 2 clover scorch disease.

Seed production was on average 6% greater than Junee with similar levels of hard seed (24%) in autumn. Seedling density was up to 12% greater than Junee. The higher levels of hard seed are considered optimum for good regeneration while still providing adequate protection against false breaks.

Coolamon's maturity makes it suitable for the medium rainfall (450-550 mm) southern wheat-belt and for pastures on the slopes and tablelands where rainfall is insufficient for later maturing cultivars such as Goulburn or Leura.

Table 30: **Characteristics of newly released subterranean clover cultivars compared to exiting cultivars** (NB: only cultivars compared in regional NAPLIP trials are included).

Cultivar	Days to flower (Wagga)	Maturity	Hard seed	Rainfall Southern NSW
Izmir	110	Very early	Very High	>360
Nungarin	110	Very early	High	>360
Dalkeith	120	Early	High	>375
Urana	125	Early	High	>400
Seaton Park LF	130	Early-mid	Moderate	>425
York	130	Early-mid	High	>425
Junee	138	Mid season	Moderate	>475
Coolamon	138	Mid season	Moderate	>475
Goulburn	145	Mid-Late	Low-moderate	>550
Denmark	149	Late	Low	>650
Leura	155	Late	Low	>700
Yanninicum cultivars				
Trikkala	122	Mid season	Low	>500
Riverina	128	Mid season	Moderate	>525
Gosse	136	Mid-late	Moderate	>600
Larisa	150	Late	Moderate	>750
Napier	150	Very late	High	>800 (irrig)
Meteora	158	Very late	High	>800 (irrig)

Napier
Napier is a very late maturing yanninicum cultivar developed to replace Larisa and Meteora which lack winter vigour. Napier produces about 5% more autumn feed and 7% more spring feed than Larisa. In late spring Napier produced 15% more feed than Larisa and 46% more than Trikkala.

It produces significantly higher seed yields than Larisa with sufficient rainfall and seedling regeneration is on average 35% greater than Larisa in the 3rd year. It produces cream coloured seed and seed size is large at about 11 mg/seed. Hard seed levels are very high with about 62% hard in autumn compared to 36% in Gosse.

Napier is a low oestrogen cultivar with formononetin levels similar to Trikkala, Gosse and Riverina, but much lower than Meteora.

It is very late maturing being similar to Larisa and 2-4 weeks later than Trikkala and 10 days later than Gosse. Due to its very late maturity it is unlikely to be suited to most dryland pastures in NSW. It would require good soil moisture until late November–early December for good seed set with an annual rainfall >750-800 mm. These conditions do not occur reliably in many southern regions of NSW unless paddocks are irrigated.

Mauro biserrula

Biserulla (*Biserrula pelecinus*) appears very similar to serradella in leaf shape but can be distinguished by its small blue flowers. Mauro biserulla produces a large seed yield which is very hard seeded (70%) at the following autumn. The high levels of hard seed ensure a good carry over of seed which is very resistant to false breaks. However unless managed properly the hardseed may inhibit good regeneration in the following year. The key to managing biserrula is to ensure residues are grazed hard over summer and to crop the paddock after the first seed set to ensure the hard seed is incorporated into the ground which aids hard seed breakdown.

Biserrula has two distinct advantages. The first is that being aerially seeding it can be readily harvested on farm using conventional headers. By harvesting their own seed farmers have a low cost source of seed for resowing. The other major advantage is that the palatability of biserrula is lower than most pasture weeds including ryegrass. Sheep will graze out most weeds before grazing the biserrula. It is therefore a valuable tool in controlling herbicide resistant weeds or in organic farming systems where herbicides cannot be used. Biserrula is more sensitive to herbicides than most other annual legumes but this is not a problem if well grazed as stock preferentially graze the weeds before the biserrula.

Some phytosensitisation has been reported in sheep grazing pure stands of biserrula in Western Australia but the incidence has been very low (less than 2% of pastures) and appears to occur in paddocks with nutrient deficiencies. Biserrula is more sensitive to herbicides than most other annual legumes but this is not a problem if well grazed as stock preferentially graze the weeds in preference to the biserrula.

Biserrula sets large amounts of pod in spring and stocking rates should be set at a level that allows sufficient flowering and seed set to occur. Given its excellent spring growth stocking rates can usually be kept at moderate levels and still allow good seed set. Herbage yields of up to 9 t/ha have been reported in NSW trials.

Erica and Margurita French serradella

French serradella (*Ornithopus sativus*) is distinguished from yellow serradella by its pink flowers. Previously Cadiz was the most widely grown French serradella cultivar but it was very soft seeded, and germinated following false breaks in late summer resulting in poor persistence. These new cultivars have higher levels of hard seed (about 50%) which protect them from out of season rainfall and have shown good persistence in low to medium rainfall (375-500 mm) areas of NSW wheat belt. Like biserulla they can be harvested on-farm using conventional headers providing a low cost source of seed for further sowing.

Erica is more prostrate in growth habit than Margurita and hence Erica is more suited to heavy grazing. Being aerial seeding the stocking rate on French serradella in spring needs to set at a level that allows good flowering and seed set to occur. Usually the strong surge in growth in spring allows stock numbers to be maintained at reasonable levels during flowering. Areas destined to be harvested for seed should be locked up at the commencement of flowering.

The most serious pest of French serradella is native bud worm which can prevent seed set. This pest can occur periodically and swards need to be monitored during flowering and pod fill and sprayed if necessary.

Additional notes:
Minimum rainfall requirement refers to total average annual rainfall in southern NSW. Minimum rainfall requirements increase in northern NSW where there is a greater proportion of summer rainfall and in some situations with poor water holding capacity or greater runoff.

Days to flower are averages based on a mid May sowing at Wagga. Cultivars take less days to flower when germination is delayed after mid May.

Plant breeders Rights:
All of the new cultivars are protected under PBR.

Acknowledgements:
The NAPLIP program is supported by grants from the Grains Research and Development Corporation and Australian Wool Innovation.

Further reading:

1. Dear, B.S., and Sandral, G.A (2004) Urana subterranean clover Agnote DPI 486. http://www.agric.nsw.gov.au/reader/past-varieties
2. Dear, B.S. and Hackney B. (2004). Napier subterranean clover Agnote DPI 488. http://www.agric.nsw.gov.au/reader/past-varieties
3. Dear, B.S. and Hackney B. (2004). Coolamon subterranean clover Agnote DPI 488 http://www.agric.nsw.gov.au/reader/past-varieties
4. Dear, B.S. and Sandral G.A. (2004) Subterranean clover, its identification and use. http://www.agric.nsw.gov.au/reader/past-varieties/p2516a.htm

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Timing of forage cut affects feed yield, quality and seed set in subterranean clover

Authors: B.S. Dear, B.F. Hackney, G.M. Dyce and C.A. Rodham.

Contact No: 02 6938 1999

Company: NSW DPI, Agricultural Institute, Wagga Wagga

Abstract:
The effect of timing of forage conservation on forage yield, forage quality, clover seed set and seedling regeneration by subterranean clover was measured over two successive years. The study was conducted on pure swards of Clare, Seaton Park, Junee and Goulburn subterranean clover at Wagga Wagga NSW. Swards were cut at 3 times to simulate an early silage (23 Sept.), late silage (9 Oct.) or hay cut (25 Oct.). Forage yield increased up to the second cutting time but thereafter either was similar or declined with a late hay cut. Feed quality declined consistently over the 3 forage harvests with IVV DM digestibility declining from 76% to 70% and protein falling from 23.5% to 16%. Seedling regeneration in the following year was good (>1000 plants/m^2) in all cultivars, except Clare, with the early silage cut, but decreased markedly with later cutting times.

Introduction:
Subterranean clover (*Trifolium subterraneum* L.) pastures often produce more feed in spring than be readily utilised by stock, resulting in poor pasture utilisation. One option is to cut the surplus feed early in spring for silage or later for hay. The impact of the time of cutting on the yield of conserved forage and its quality is not well documented. It is generally assumed that the later the cut, the more feed, but the trade-off in quality may offset this advantage. Another question is the effect of different cutting times on subsequent seed set by the subterranean clover and its ability to regenerate the following year. The following study examined the effect of an early silage cut, late silage cut or a later hay cut on the yield and quality of herbage from 4 subterranean clover cultivars and seedling regeneration the following year.

Materials and methods:
Pure swards of Seaton Park, Junee, Goulburn and Clare subterranean clover at the Agricultural Institute, Wagga Wagga, New South Wales, were cut on 23 September (early silage), 9 October (late silage) or 25 October (hay cut) in two successive years, 2003 and 2004 after being locked up on 1 August. Plots were 2m x 8m and arranged in a randomised plot design with 4 replications. Total yield and quality of the cut forage was measured as were subsequent seed yields and clover regeneration. In both years the forage was cut at a height of 3cm, but in 2004 an additional cutting height of 6cm was included as a treatment to determine the effect of a more lenient cutting. Total annual rainfall was 438mm in 2003 and 402mm 2004, compared to a long term average rainfall of 580mm.

Results and Discussion:
Forage yields increased with the later cutting only up until the middle cut in both years. Delaying the conservation cut further until late October usually resulted in lower yields in 2003 (Table 31) or similar yields in 2004 (Table 32). The lack of additional yield was most likely due to the higher respiration and leaf decay due to shading as a result of the dense canopies.

The results show that where a later hay cut is intended, delaying the lock up time and grazing for longer may be more efficient, rather than loosing herbage due to decay.

Table 31: Forage yield (t/ha) from 4 cultivars of subterranean clover cut early (23 Sept), mid (9 Oct), or late (25 Oct) in 2003

	Cultivar			
Cutting time	**Seaton Park**	**Junee**	**Goulburn**	**Clare**
Early (early silage)	3.25	3.79	3.68	3.93
Mid (late silage)	10.39	10.4	8.56	10.98
Late (hay)	8.42	7.36	6.53	7.62

Table 32: Effect of cutting time (early silage, late silage and hay cut) and cutting height (low 3 cm or high 6 cm) on forage yield (t/ha) of 4 subterranean clover cultivars in 2004

	Cultivar							
	Seaton Park		**Junee**		**Goulburn**		**Clare**	
Cutting height/time	low	high	low	high	low	high	low	high
Early (early silage)	3.0	2.0	3.9	2.7	3.3	2.2	4.7	3.7
Mid (late silage)	5.9	3.1	5.0	3.8	5.2	3.6	5.3	3.4
Late (hay)	4.3	3.3	5.3	3.0	5.1	2.6	5.0	3.9

The trend in herbage quality with time as measured by digestibility and protein quality was very consistent. The later the feed was conserved the greater the decline in digestibility (Table 33) and protein content (Table 34) with an average decline of 6% in digestibility units and 7% units in protein. Conserving feed as hay in preference to silage greatly reduced the potential quality of the conserved fodder. The actual quality of the forage will depend on the ability to convert the cut material into high quality conserved forage, but it could be argued with modern silage making techniques, losses from silage may be lower than from hay which is more susceptible to the vagaries of weather due to the longer drying time required compared to silage.

Table 33: Effect of cutting time on digestibility (DMD%) of 4 cultivars of subterranean clover cut for silage or hay in 2003

	Cultivar				
Cutting time	**Seaton Park**	**Junee**	**Goulburn**	**Clare**	**mean**
Early (early silage)	77	77	78	76	76
Mid (late silage)	73	74	75	73	74
Late (hay)	70	71	71	68	70

Table 34: Effect of cutting time on crude protein (%DM) of 4 cultivars of subterranean clover cut for silage or hay in 2003

	Cultivar				
Cutting time	**Seaton Park**	**Junee**	**Goulburn**	**Clare**	**mean**
Early (early silage)	22	25	25	22	23.5
Mid (late silage)	17	21	20	19	19.3
Late (hay)	14	17	17	16	16.0

Clover seed set and subsequent seedling regeneration declined with later cutting, suggesting that the early cut provided more time for the clover to recover (Figure 20). This was supported by the good correlation between the amount of herbage remaining at the end of the season and subsequent clover seed yield. For all cultivars except Clare, clover seedling regeneration following a late September cut was good with more than 1,000 seedlings/m^2 but was less satisfactory with the early or late October cutting times.

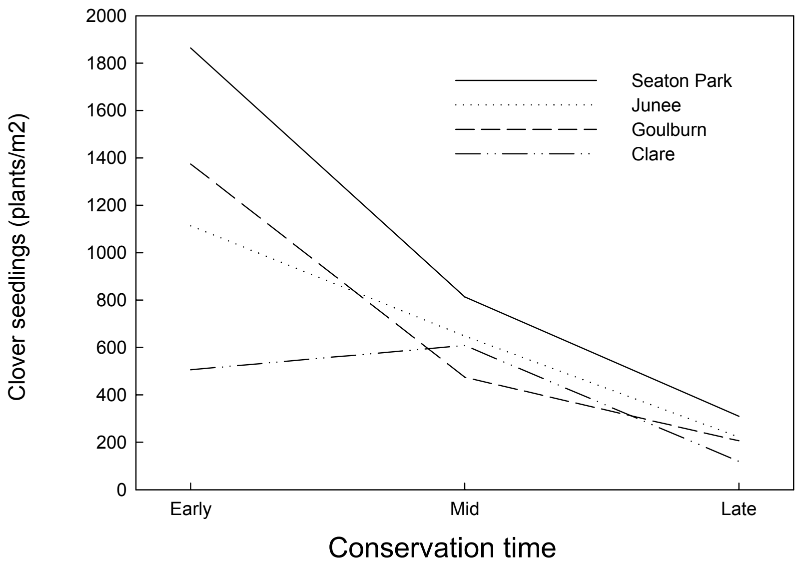


Figure 20. Effect of forage cutting time on clover seedling regeneration by 4 cultivars in autumn of the following year (2004)

Despite Clare appearing taller and more productive than the other cultivars, this apparent advantage was deceptive with clover cultivar having only a minor impact on subterranean clover herbage yield and quality. Cultivars did however differ in their response to cutting in terms of seed yield and seedling regeneration. The three cultivars belonging to the subterraneum subspecies recovered well from cutting, but Clare, which belongs to the brachycalicinum sub species, was less able to recover from the early cut and produced less seed and had poorer regeneration in the subsequent year than the other three cultivars (Figure 20). Clare is a more upright cultivar with thicker petioles and stems and it was apparent after cutting that more of the runners were removed compared to the more prostrate cultivars.

Conclusions:

The results show that subterranean clover pastures can be cut early for silage and still recover to set sufficient seed for good seedling regeneration in the subsequent year. Cutting later for hay reduces the digestibility and protein of the forage compared to earlier cutting for silage. Given that a 1% unit change in digestibility will result in a 3-5% change in liveweight gain, a decrease in digestibility from 76% to 70% will decrease the potential animal liveweight gain achieved from the forage by 18-30%.

Locking up a pasture for too long decreased total forage yield with losses due to decay and shading countering any benefits flowing from the additional lock up period.

Herbage yields and seed set following cutting are likely to vary with seasonal conditions however both years received below average rainfall and therefore the results should be achievable in most average or better seasons. In regions with an earlier finish to the growing season, seed yield recovery could be expected to be poorer than reported here.

The effects of different phosphorus seedbed utilisation on crop and weed performance

Authors: Leigh Sargeant and Ken Young

Contact No: 03 5833 9200

Organisation: University of Melbourne

Key message:
- Lower Seed Bed Utilisation (SBU) increased plant establishment with deep banded P having the highest plant numbers.

Aim:
To investigate crop response to different seed bed utilisation (8% up to 100%) by utilising different phosphorus fertiliser placement.

Method:
A field experiment was established at Serpentine, Victoria on a red clay loam soil. Mitre wheat was sown at 90 kg/ha on 8 June 2004. Fertiliser (DAP 85 kg/ha) was applied by different means (Table 35), with urea applied at 100 kg/ha as a top dressing on 1 August 2004 The placement treatments were broadcast, conventional 18cm spacing, wide spacings (30cm), paired rows and deep banded

Table 35: Phosphorus placement treatments to achieve different SBUs

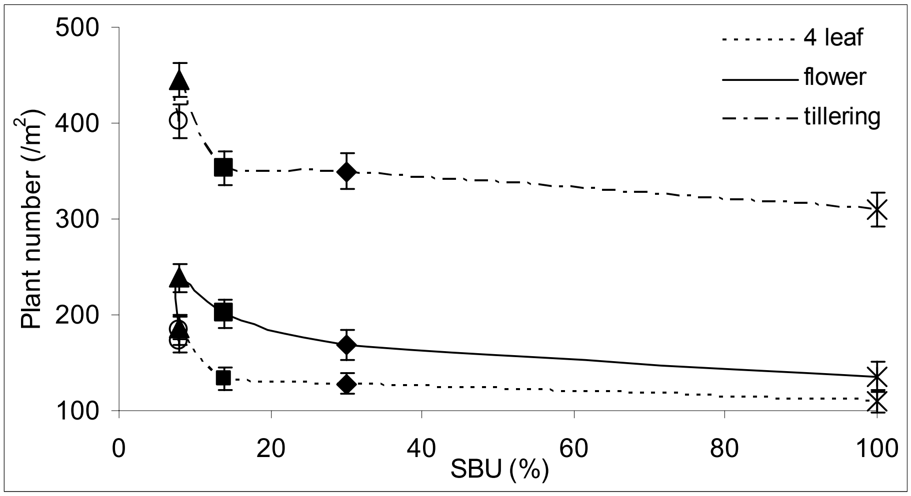
Treatment	Seed bed utilisation (SBU)
Broadcast and seed incorporated	100%
Conventional: band with seed on 18cm spacing	14%
Conventional: band with seed on 30cm spacing	8%
Conventional: band with seed using paired row on 18cm spacing	30%
Deep band on 30cm spacing	8%

Plant counts were conducted at Z14, Z30 and Z60. Also plant emergence was counted every four days from time of sowing until plant reached Z14. Root mass was extracted 20 days after sowing and weighed.

The plots were not harvested due to both the poor season leading to harvest, and the reporting period required for the University.

Results:
Fertiliser placement had a significant effect on plant establishment and plant numbers throughout the experiment with low SBUs (<20%) achieving and obtaining higher plant numbers than high SBUs (>30%) (Figure 21). The deep banded phosphorus had the best plant numbers throughout the experiment.

There was no statistical difference between treatment for either rate of plant emergence or initial root mass (Table 36).



Phosphorus application by either broadcast (✱), conventional 18 cm spacing (■), wide spacings (30 cm) (○), paired rows (◆) and deep banded (▲)

Figure 21. The effect of fertiliser placement seedbed utilisation on plant numbers at Z14 (4 leaf), Z30 (tillering) and Z60 (flowering) stages

Table 36: The effect of Phosphorus spacing application (SBU) on initial root mass (20 days after sowing) and rate of emergence (days to 50% emergence)

Treatment	Seed bed utilisation (SBU)	Emergence rate (days to 50% emergence)	Initial Root Mass (mg/plant)
Broadcast and seed incorporated	100%	13.3	24.3
Conventional: band with seed on 18cm spacing	14%	12.0	31.5
Conventional: band with seed on 30cm spacing	8%	12.0	22.4
Conventional: band with seed using paired row on 18cm spacing	30%	15.8	22.5
Deep band on 30cm spacing	8%	14.8	22.5

The effect of dinitroaniline herbicides on the legumes rhizobium symbiosis

Authors: Brad Bennett and Ken Young

Contact No: 03 5833 9200

Organisation: University of Melbourne

Key messages:

- Trifluralin and pendimethalin caused root length and nodule reduction in peas under field conditions.
- Trifluralin decreased the growth of rhizobia under laboratory conditions.

Aim:
To investigate the cause of lower nodulations levels in pulse crops where Group D herbicides (trifluralin and pendimethalin) have been used.

Method:
Both a field experiment and a laboratory experiment were conducted. In the field experiment trifluralin and pendimethalin were applied at the registered rate (Table 37) just after sowing and followed by a light harrowing. After 11 weeks plants were sampled for root length, root and shoot dry weight, and nodule score (0 to 5 range, where a low score reflects poor nitrogen fixation and a high score high nitrogen fixation).

The laboratory experiment investigated the effect of these herbicides on the growth of rhizobia under controlled conditions in a yeast mannitol broth. A cultured strain of the rhizobia was obtained from the NSW Department of Agriculture. The laboratory study rates used were dilutions equating to one, two and four times the registered rate. These were applied as a dilution into 50mL of rhizobia broth. Spectrometer readings on the broth were conducted giving an indication of growth of the rhizobia within the broth.

Table 37: Chemical rates as applied in the field and laboratory experiments

Rate	Description	Trifluralin (Treflan)	Pendimethalin (Stomp)
0	Control	0 g ai/ha	0 g ai/ha
1x	Registered rate*	864 g ai/ha (1.8 L/ha)	825 g ai/ha (2.5 L/ha)
2x	Double Registered rate	1728 g ai/ha (3.6 L/ha)	1650 g ai/ha (5 L/ha)
4x	Quadruple Registered rate	3456 g ai/ha (7.2 L/ha)	3300 g ai/ha (10 L/ha)

*Registered rate of application (HerbiGuide 2003)   ai – active ingredient

Results:
The herbicide rate had the most effect, reducing root dry weight and length, tops dry weight and nodule number (Table 38). Trifluralin had a greater effect than pendimethalin on nodule number and rate, and herbicides had differing effects on nodule score with trifluralin at the highest rate causing severe reduction in nodule score (Table 39).

Table 38: The effect of herbicide rate on dry weight, root length and nodule number of field peas

	Registered herbicide rate					
	0		1x		2x	
Tops Dry Weight (g)	4.8	b	2.3	a	2.4	a
Root dry weight (g)	1.8	d	0.9	c	1.0	c
Root length (mm)	20.1	f	15.5	e	15.2	e
Nodule Number	33.2	h	18.6	g	14	g

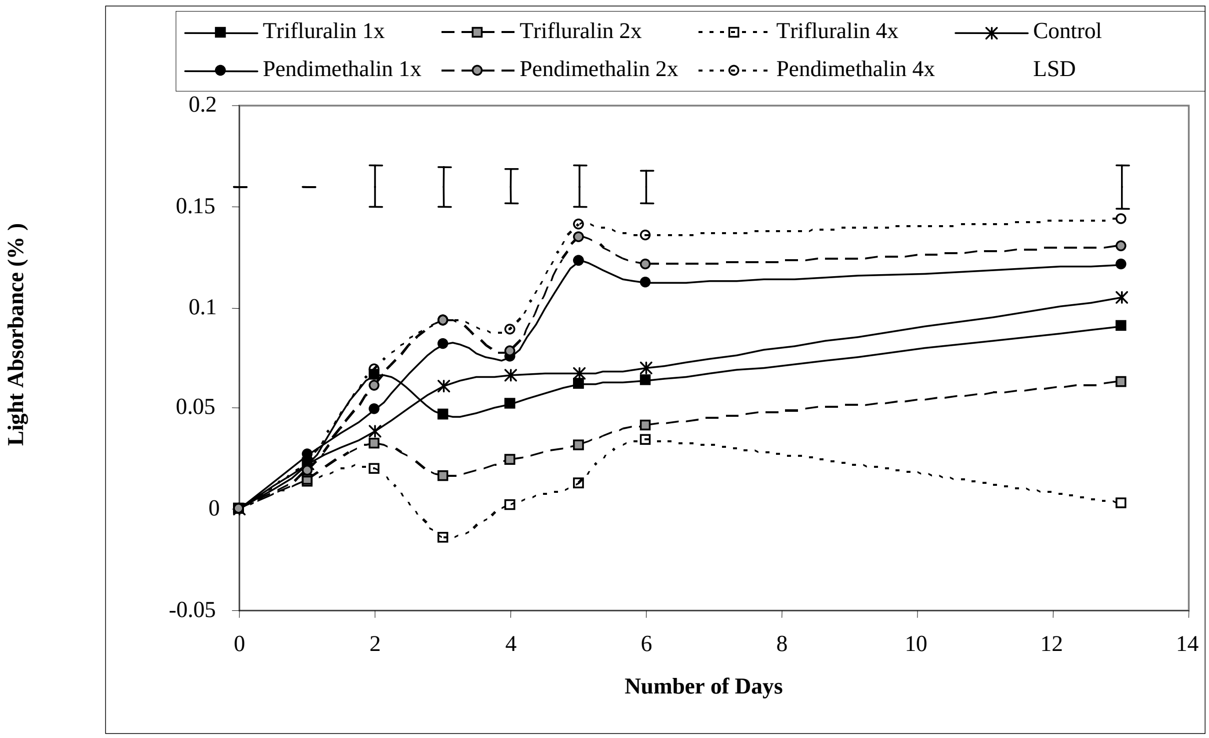
Different letters within a row represent significant difference between treatment effect according to Fisher's protected lsd ($p<0.05$).

Table 39: The effect of the herbicide type and rate on nodule score of rhizobia on field peas

	Registered herbicide rate*					
	0		1x		2x	
Trifluralin	4.3	c	3.2	b	1.8	a
Pendimethalin	4.2	c	2.9	b	3.0	b

Different letters represent significant differences between treatment effects according to Fisher's protected lsd ($p<0.05$).

In the laboratory study, the least absorbance occurred under the highest trifluralin rate indicating the least amount of growth of rhizobia. The highest absorbance occurred with pendimethalin at the highest rate, which suggests that this had the greatest amount of rhizobia growing in it. As both trifluralin and pendimethalin decreased root growth and nodulation score, the spectrometer results need further clarification to determine the difference between the absorbance spectra for the two herbicides.



Bars represent fisher protected lsd for each sampling time.

Figure 22. Growth of rhizobia over 13 days, as per treatments

Observations and comments:

Trifluralin and pendimethalin at registered rates had a negative effect on plant growth and nodulation when applied under field conditions. Increased rates of these herbicides had an increased effect on plant growth and nodulation when compared to the untreated control. As a result, farmers should seek further information on alternative herbicide treatments for the pre-emergent control of weeds in field peas, if they are aiming for the optimum nitrogen benefit from their legume crop.

The effect of root fragment size and burial depth on the survival of prairie ground cherry

Authors: Steven Faulkner and Ken Young

Contact No: 03 5833 9200

Organisation: University of Melbourne

Key messages:

- Cultivation alone is unlikely to reduce prairie ground cherry in dryland crop situations.
- Fragment size required to be less than 2.5cm before death occurs.
- Burial depth of greater than 20cm was required before significant death of fragments occurred.

Aim:
To determine the regeneration capacity of prairie ground cherry from different root fragments lengths and different burial depths.

Method:
Fragments of prairie ground cherry were extracted from the soil, then cut up into four fragment sizes – 1cm, 2.5cm, 5cm and 10cm. The fragments were buried at depths of 5, 10 or 20 cm. The treatments were replicated six times. The fragments were extracted, cut up and replanted in June 2003 and were recovered in April 2004. Both original weight and final weights were recorded as was the number and time of any regeneration shoots.

Results:
The deeper the fragment burial the greater time required for emergence, with shallow burial depths taking 1 to 2 months but the 20cm depth taking 3 – 5 months.

Both fragment length and burial depth affected survival of the root fragments with fragment length needing to be 2.5cm or less to achieve a significant effect on survival. Also fragments need to be at a depth of 20cm again to achieve a reasonable level of control (Table 40).

Table 40: Effect of root length and burial depth on fragment survival (%)

Root length (cm)	Survival (%)		Burial Depth (cm)	Survival (%)	
1.5	25.4	a	5	55.1	b
2.5	22.3	a	10	52.7	ab
5.0	55.6	b	20	26.4	a
10.0	89.9	c			
lsd	16.1		lsd	14.0	

The same letter within a column indicates a non significant difference between treatments ($p<0.05$).

While survival can be affected by either burial depth or size of fragment, both the depth and size required are not applicable in broadacre cropping. Hence, alternatives need to be considered, such as some cultivation to stimulate dormant buds, then an application of herbicide. This is the next area of research that is required.

The effect of lime coating seed on pea growth and yield

Authors: Ashley McQualter and Ken Young

Contact No: 03 5833 9200

Organisation: University of Melbourne

Key message:

- Lime coating seed caused a reduction in plant emergence though this did not affect final dry matter production.

Aim:

To determine the effect of lime coating on pea establishment and yield.

Method:

Peas were either coated or uncoated with lime and sown into plots with or without lime (2 t/ha). The paddock was a duplex soil with a pH ($CaCl_2$) of 4.9. All seed was treated with inoculum. The lime coated seed was coated with a slurry of lime using a cement mixer.

Measurements included plant establishment, emergence rate, dry matter production and final soil pH were recorded.

Results:

The only statistical difference was in plant establishment with seed not lime coated having better establishment than lime coated seed. There also was a visual difference between these treatments with the no lime coated seed appearing a healthy green colour where the lime coated seed had a pale colour.

Table 41: Effect of lime coating per seed on plant growth and soil pH

Lime	Seed Coat	Plant Establishment (plants/m2)	Emergence Rate (days to 50% emergence)	DM production (t/ha)	Final pH $CaCl_2$
No	No	104.5	11.8	6.80	4.94
Yes	No	99.5	11.0	6.69	4.71
No	Yes	80.2	10.5	6.60	4.66
Yes	Yes	71.5	8.8	6.43	4.63
	lsd	9.9	n.s.	n.s.	n.s.

n.s. – non significant

Phosphorus response under different P levels and organic matter

Authors: Paul Slater and Ken Young

Contact No: 03 5833 9200

Organisation: University of Melbourne

Key messages:
- Paddocks with high organic matter provided better yield and a better return on investment than low organic matter paddocks.
- In high yielding paddocks care is required to ensure depletion of soil P is not too great.

Aim:
To investigate the effect of organic matter on wheat yield response.

Method:
Two paddocks at the University of Melbourne's Dookie Campus, differing in organic matter (OM) were used in this experiment. Paddocks chosen differed in OM content being low (1.6% OM) and high (2.7% OM), respectively. A base treatment of 100kg/ha of DAP at sowing and 100kg/ha of urea was applied to each paddock. Extra phosphorus was added at 20kg P/ha in the form of triple super phosphate (100 kg/ha).

Plant counts were conducted at Z12, Z30 and Z60. Plant samples were taken in November and yield estimates were determined through counting tiller number and grains per head. Yield was estimated from whole paddock yield estimates.

An analysis of variance was conducted between treatment within a paddock, and t-tests were done between paddocks on the same treatment.

An economic analysis was conducted using the assumptions of cost of triple superphosphate $400/t, fertiliser rate of 100 kg/ha and wheat price of $180/t.

Results:
Adding extra phosphorus improved yield in both the low and high organic matter paddocks (Table 42). The greater yield obtained was through the increase in the number of grains per head achieved with more available phosphorus. The high organic matter paddock provided a better base for higher yields through greater tiller numbers both at the end of tillering and approaching harvest. Higher grains per head also occurred on the high OM paddock.

The high OM paddock provided better returns (Table 43), though caused a reduction in the Olsen P level indicating a drain on the soil P. The low OM paddock increased soil P levels indicating that there was another limitation to this paddock to achieve maximum yield. As this paddock had been in cropping for a longer period of time than the high OM paddock, it may have been a rooting depth problem caused by a hard pan. This then effectively reduced the amount of water available to the crop reducing final yield.

Table 42: The effects of added phosphorus on Yield components

	Treatment	Tiller No. @ Z30	Grains/head	Tillers /m2 @ Z70	Estimated yield (t/ha)
Low OM paddock	Added P	127.8	43.1	517.0	3.94
	normal	125.5	39.8	441.5	3.11
	lsd	n.s.	2.4	n.s.	0.55
High OM paddock	Added P	178.3	49.6	698.5	6.11
	normal	166.5	46.5	620.0	5.08
		n.s.	2.4	n.s.	0.95
T-test comparisons low vs high OM (probability values %)					
	Added P	1.9%	0.1%	0.1%	0.01%
	Normal	0.2%	0.1%	0.6%	0.1%

Probability values indicate the chance that the two treatments are the same.

Table 43: The final Olsen P levels and economics of added phosphorus application

		Olsen P level	Yield Increase	Return ($/ha)
Low OM paddock	Initial soil test Olsen P	8.4		
	Added P	16.2	0.73	$91
	normal	13.2		
High OM paddock	Initial soil test	17.5		
	Added P	10.8	1.04	$147
	normal	14.8		

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Filling the Feed Gap – Grain and Graze

Author: Kirrily Condon[1], Guy McMullen[2]

Contact No: [1]02 6924 4633, [2]02 6938 1633

Organisation: [1]FarmLink, [2]NSW DPI

Key Messages:
- Whistler, Wedgetail and Lorikeet produced the greatest grazing dry matter regardless of sowing time.
- Marombi yielded highest, favoured by late rain.
- Economics show advantage for grazing wheats, particularly those with higher dry matter production.

Background:
Balancing the cropping and pasture phases in mixed farming enterprises can be difficult, with one often being traded off against the other. The Murrumbidgee Grain & Graze project is one of 9 across Australia targeted at improving the triple bottom line of mixed farming enterprises. The Murrumbidgee project involves FarmLink, NSW DPI, CSIRO, Charles Sturt University and the Murrumbidgee Catchment Management Authority. The project began in 2004 and will conclude in 2008.

Aim:
To identify profitable rotations that compliment both the cropping and livestock enterprises, with particular emphasis on producing late autumn/winter feed to fill the feed gap, without compromising the cropping phase.

Method:
Grazing wheat agronomy trials were established at Marrar and Yerong Creek. Site statistics are shown in Table 44. Feeding preference (Animal preference) and liveweight and intake (Animal response) trials were conducted at the Marrar site only.

The animal preference trial included the six varieties sown in the grazing trial, in 2.4m x 20m plots sown on the 27th of May. Plots were grazed for 24 hours on the 10th of August.

The liveweight and intake trial utilised three varieties (Whistler, Wylah, Wedgetail) sown on the 27th of May into 0.2 ha plots replicated three times. Plots were stocked by 25 lambs/ha (35kg/hd) from the 10th to the 30th of August.

Table 44: Grazing trial statistics

Site	Marrar	Yerong Creek
Trials	Grazing	Grazing
Growing Season Rainfall (April –October)	287 mm	261 mm
Rotation	2003: lupins	2003: canola
Varieties	Lorikeet, Whistler Mackellar, Wylah Marombi, Wedgetail ungrazed (S2) Wedgetail, Diamondbird (S2)	Lorikeet, Whistler Mackellar, Wylah Marombi, Wedgetail ungrazed (S2) Wedgetail, Diamondbird (S2)
Sowing dates	S1: 13th April dry (germinated 25th May), S2: 27th May, S3: 8th June	S1: 13th April dry (emerged 2nd May), S2: 23rd May, S3: 9th June
Deep N	159 kg/ha	250 kg/ha
Fertiliser	100kg/ha MAP with seed, 100kg/ha urea early Sept	100kg/ha MAP with seed, 80kg/ha urea early Sept
Plant establishment (plants/m^2)	S1: 140/m^2, S2: 170/m^2, S3: 190/m^2 (80 kg/ha)	S1: 140/m^2, S2: 160/m^2, S3: 180/m^2 (80 kg/ha)
Fungicide	triadimenol (Baytan) on seed; propiconazole (Tilt) 7/10	triadimenol (Baytan) on seed; triadimefon (Bayleton) 2nd week October.
Grazing (crash grazed to 500kg DM/ha)	S1 & S2: 10th-14th August	S1: 10th-13th July, S1 & S2: 10-13th August

Results:

Marrar

Grazing wheat trial – agronomy:
Despite late sowing, the Marrar trial produced an average of 2.6t dry matter/ha up until the end of August, and yielded an average of 2.6t/ha grain.

Grazing preference:
Lambs were offered equal access to 6 grazing wheat varieties over a 24 hour period. There was no significant difference in preference for any variety.

Liveweight and intake:
Liveweight was measured in lambs (starting weight ~35kg) every 10 days for a 20 day period to determine weight gain on 3 different varieties. Animals were also dosed with alkane marker boluses to measure daily feed intake.

Liveweight gain averaged 215g/hd/day, with no significant difference between varieties. There was also no effect of variety on feed intake, averaging 1.25kg/hd/day across varieties (assuming diet contained 100% wheat), or ~3% of liveweight for 40kg lambs.

Grazing dry matter (to end August):
Dry matter (DM) between sowing times, particularly S1 and S2, were similar for most varieties as emergence dates were relatively close together (Figure 23). The exception was Wylah which had a significant reduction in dry matter after the first sowing time. Feed quality was high across varieties (ave. 85% digestibility, 32% crude protein in early August).

Yield:
There was no effect of sowing time on yield, probably due to the similarity in emergence dates and dry season (Figure 24). However there was a varietal effect, with Whistler, Marombi and Wedgetail producing the highest yields.

Protein & screenings:
Protein was high for all varieties, above 14%. It also increased with sowing time (significantly from S1 to S2). Screenings were variable, ranging from 2% for Marombi to 21% for Lorikeet (Figure 25).

Ungrazed comparisons (2nd sowing - 27th May):
There was no significant yield difference between all grazed winter wheats and the ungrazed winter wheat (Wedgetail). However the spring wheat comparison (Diamondbird) yielded significantly less than the winter wheats (Figure 26).

Economics:
The gross margins below were calculated from yields and grazing dry matter results of the 2nd sowing time, allowing comparison between grazed vs ungrazed winter wheats vs spring wheat (Figure 27).

All grazed wheats gave better returns than the ungrazed comparison (Wedgetail), which in turn was better than the spring wheat (Diamondbird).

Returns were higher in grazing wheat varieties which produced more grazing dry matter (eg. Whistler, Wedgetail), despite other varieties producing equal or higher yields, (eg. Marombi). There was also an advantage to growing the Prime Hard Wedgetail over the ASW Whistler, despite Wedgetail having lower yield and grazing dry matter (note in this trial no additional urea was required to achieve Prime Hard so costs were the same).

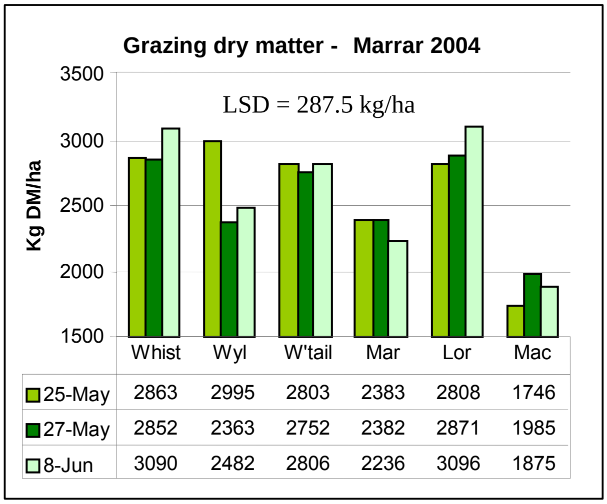


Figure 23.

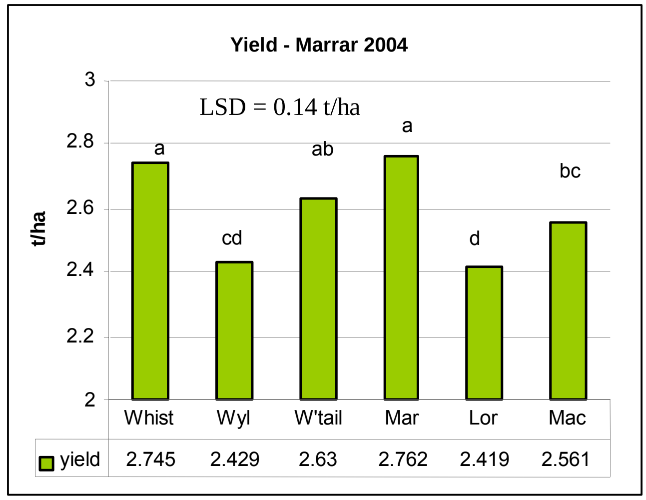


Figure 24. Same letters not significantly different.

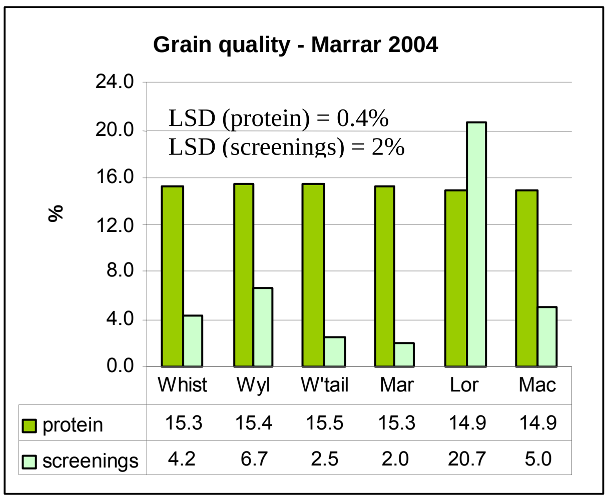


Figure 25.

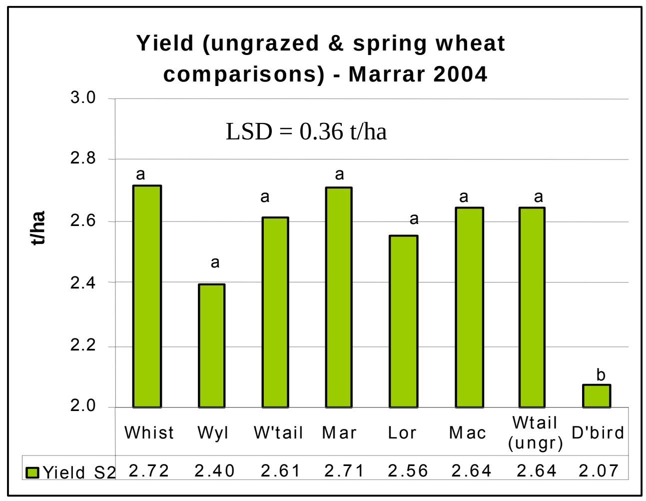


Figure 26. Same letters not significantly different.

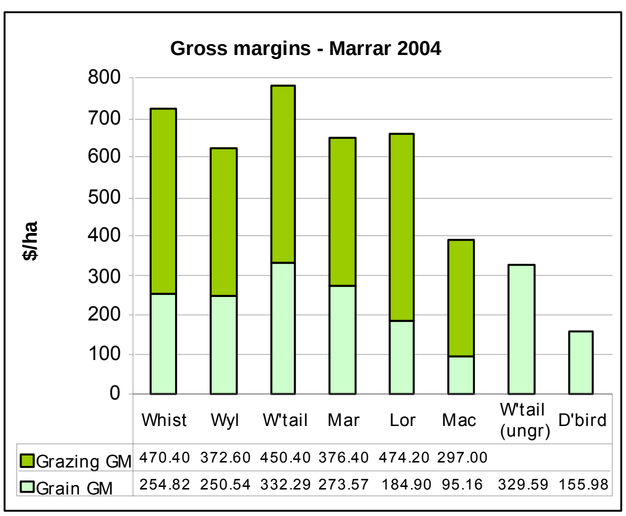


Figure 27.

The following assumptions were made in the gross margin analysis:

- liveweight gain calculated using a feed conversion ratio of 8
- liveweight gain valued at $1.60/kg
- grain variable costs valued at $275/ha
- grain income calculated from Golden Rewards Sept 04

Yerong Creek

Grazing wheat trial – agronomy:
The Yerong Creek trial produced an average of 2.5t dry matter/ha up until the end of August, and yielded an average of 3.3t/ha grain.

Grazing dry matter (to end August):
As shown in Figure 28, dry matter (DM) was significantly higher at the 1st sowing time, declining with sowing date (less of an effect in Whistler and Wedgetail). Whistler, Wedgetail and Lorikeet generally produced greater dry matter and Mackellar least. Feed quality was high across varieties (ave. 81% digestibility, 28% crude protein in early August).

Yield:
Marombi yielded highest at all sowing times (Figure 29). Yields of other varieties varied with sowing time, with differences usually less than 0.5t/ha.

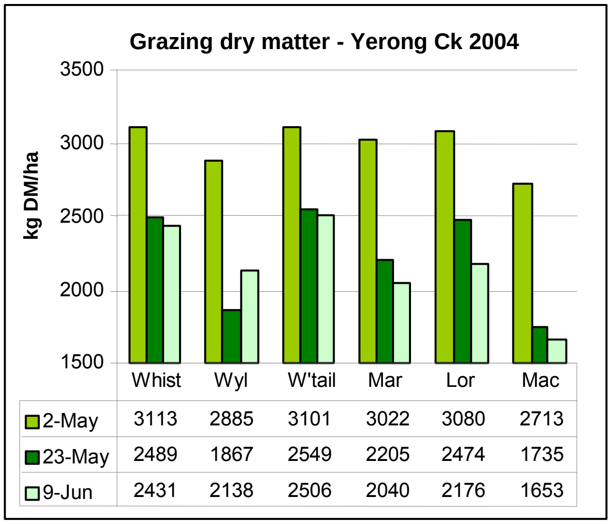
Protein & screenings:
Protein was high for all varieties, above 13%, and increased significantly with sowing time (Figure 30). Screenings were generally high, with Wedgetail and Marombi least affected.

Ungrazed comparisons (2nd sowing - 23rd May):
Figure 31 shows that all grazed winter wheats except Wylah yielded significantly better than the ungrazed winter wheat (Wedgetail). No grazed wheat yielded less than the spring wheat (Diamondbird) but Marombi, Wedgetail and Lorikeet yielded significantly more.

Economics:
The gross margins in Figure 32 were calculated from yields and grazing dry matter results of the 2nd sowing time, allowing comparison between grazed vs ungrazed winter wheats vs spring wheat.

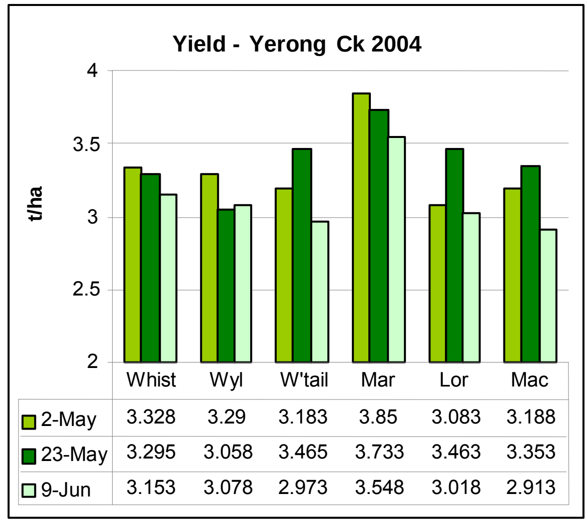
All grazed wheats gave better returns than the ungrazed comparison (Wedgetail), which in turn was better than the spring wheat (Diamondbird).

Returns were highest for Wedgetail due to its greater dry matter production, despite a lower yield than Marombi. It also attracted a Prime Hard premium. However the increased dry matter production of Whistler over Marombi was not enough to make up for its lower yield.



LSD = 359.7 kg/ha

Figure 28.



LSD = 0.34 t/ha

Figure 29.

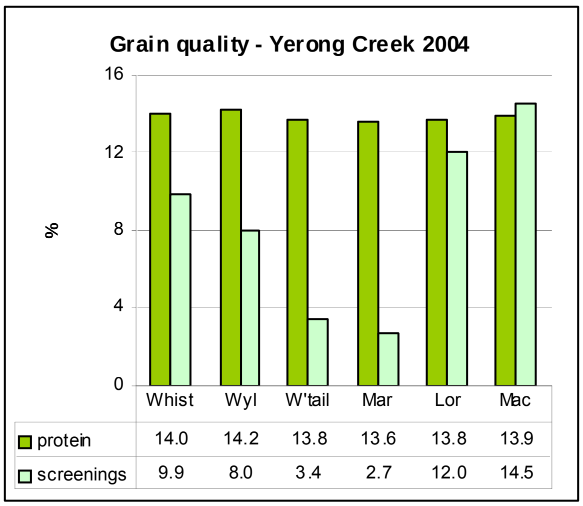
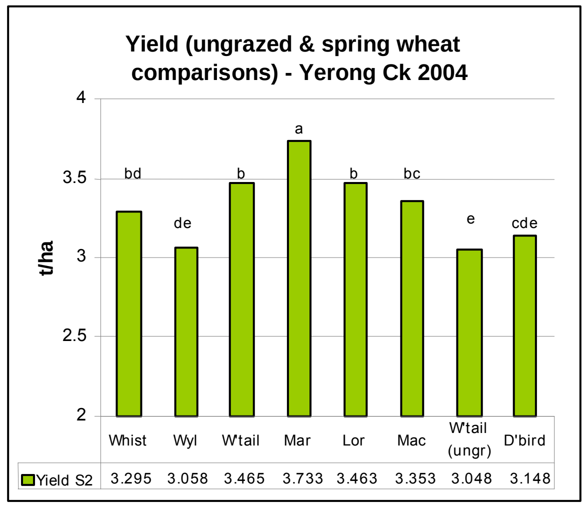


Figure 30.

LSD (protein) = 0.3%
LSD (screenings) = 2%



LSD = 0.24 t/ha

Figure 31. Same letters not significantly different.

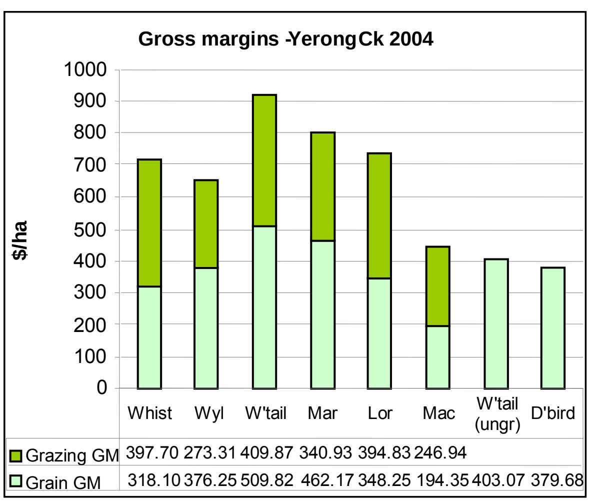


Figure 32.

The following assumptions were made in the gross margin analysis:

- liveweight gain calculated using a feed conversion ratio of 8
- liveweight gain valued at $1.60/kg
- grain variable costs valued at $275/ha
- grain income calculated from Golden Rewards Sept 04

Source:
FarmLink Research Report 2004

Acknowledgements:
Kirrily Condon (FarmLink), Guy McMullen (NSW DPI), Hugh Dove (CSIRO), Warren Bond (CSIRO), Jim Virgona (CSU).

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Addressing canola yield decline

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Organisation: FarmLink

Key Message:

- Disease is the driver of canola yield decline in high rainfall areas to the east (>600mm).
- The cause of yield decline in lower rainfall areas (<600mm) is less obvious due to lack of disease since the project's inception, although subsoil constraints have been identified as contributing to low yields in the south.
- Late sowing causes significant yield loss at ~ 16 kg/ha/day.

Aims:

To quantify the impact of disease on southwest slope canola yields, and to determine if there were factors other than disease contributing to canola yield decline.

Methods:

Paddocks surveys

Forty five paddocks in three regions: North (north of Cootamundra - > 500mm), Central (north of Wagga - <500mm) and South (south of Wagga - < 600mm). Survey details included:

- paddock history and crop management, insect and herbicide damage;
- micronutrient testing, blackleg leaf lesion assessment, general disease check (6-8 leaf stage);
- root restriction assessment, sclerotinia petal test, virus test (30% flower);
- blackleg lodging and root rot assessment, sclerotinia assessment (pre-windrowing); and
- yield and oil.

In response to the high level of root restriction observed in 2003 in the southern area, 12 additional paddocks were sampled (to 1.8m) to assess the impact of subsoil conditions on root growth and water extraction.

The crop model APSIM was used to determine the impact disease and other factors including subsoil problems are having on canola yields.

Results:

Root restriction

Root restriction is scored on a scale of 0-5, with 0 showing no restriction and 5 showing severe 'J-root' symptoms Figure 33. Previous research has identified a rating above 2.5 as possibly yield limiting.

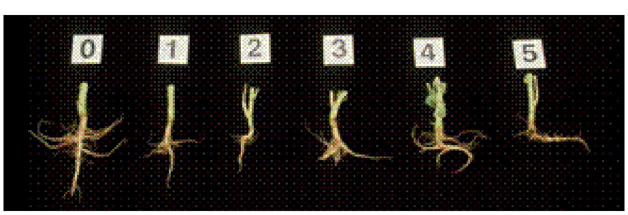

Figure 33. Root restriction is scored on a scale of 0-5

Sixty percent of paddocks surveyed in the southern zone had root restriction scores of three or above (Table 45). This was the same as the 2003 survey.

Table 45: Average root restriction scores per region 2004

Region	Score (0-5)	% above score 3
North	1.6	0%
Central	2.1	28%
South	3.0	60%

Subsoil analysis of paddocks in the southern region indicated that the most common constraints were salinity, sodicity and compaction (Table 46).

Table 46: Subsoil testing 2004 (X = high, ? = borderline)

Paddock	Acidity	Salinity	Sodicity (sub)	Compaction
Springhurst			**X**	
Yarrawonga		**X**	**X**	
Corowa				**X**
Rand		**?**	**?**	**?**
Rand		**X**		
Rand		**?**	**X**	**?**
Walla Walla	**X**		**X**	**X**
Culcairn				
Culcairn	**X**		**X**	**?**
Culcairn				
Lockhart		**X**		**X**
Lockhart		**X**		

Source: John Kirkegaard, CSIRO

Sampling at harvest indicated rooting depth varied from 85cm at the Lockhart Canola Plus site to 180cm at two paddocks around Culcairn, with most other paddocks reached 140cm. One exception was a paddock at Rand in which roots only reached 100cm – it was the only one that didn't dry the soil down to wilting point at harvest. Compared with other paddocks with no apparent subsoil constraints and roots growing to 180cm, a rooting depth of 140cm may suggest some limitation, even more so where roots only grew to 90-120cm.

Blackleg - root rot and stem canker

Root rot and stem canker were widespread in 2004 (Table 47).

Table 47: Average blackleg root rot & stem canker levels 2004

Region	Root rot		Stem canker	
	% plants infected/pdk	severity rating (0-5)	% plants infected/pdk	% severity
North	59%	1.3	53%	9.4%
Central	35%	0.7	35%	6.4%
South	48%	1.3	42%	7.6%

Source: Susie Sprague, CSIRO

Root rot was found in all paddocks surveyed in 2004, although severity levels were low. There was a strong relationship between the severity of root rot and severity of stem canker (the symptom usually associated with blackleg-related yield loss) in the paddock, although single plants can show symptoms of one without the other. The presence of root rot symptoms in paddocks that had never grown canola before suggests that root rot develops from infection by airborne spores entering from the leaves, not from the soil via the roots.

Crop modelling

The APSIM canola model calculates potential yields for a given variety, sowing date, daily weather conditions, plant density, and available soil water and nitrogen. It predicts crop yields that are free from pests, weeds, diseases and nutrient deficiencies. It has been tested against commercial paddocks and trials in southern NSW over recent years. Estimates of potential yields have shown close agreement with measured yields. Model predictions have shown that **canola crops in southern NSW yield to their potential when they are kept disease-free.**

Modelling the 2003 data indicated:

- strong relationship between yield and:
    - April to October rainfall (within and between regions)
    - sowing date (only when regions combined)
    - total nitrogen (especially southern region)
- no clear relationship between yield and:
    - root restriction rating
    - blackleg
    - sclerotinia
- micronutrient levels were generally not limiting.

Discussion of model outputs at grower meetings in 2004 indicated that discrepancies between predicted yields vs actual yields could be explained by the likelihood of frost damage, late harvests or the role of subsoil constraints.

Source:
FarmLink Research Report 2004

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