mallee sustainable farming

2009 KERRIBEE FIELD DAY

THURSDAY 27TH AUGUST

Rabobank

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Lower Murray Darling CMA CATCHMENT MANAGEMENT AUTHORITY

Mallee Sustainable Farming Inc. would like to thank the following organisations for their support of the 2009 Kerribee Field Day

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MSF Kerribee Station Trial Site 2009 plan

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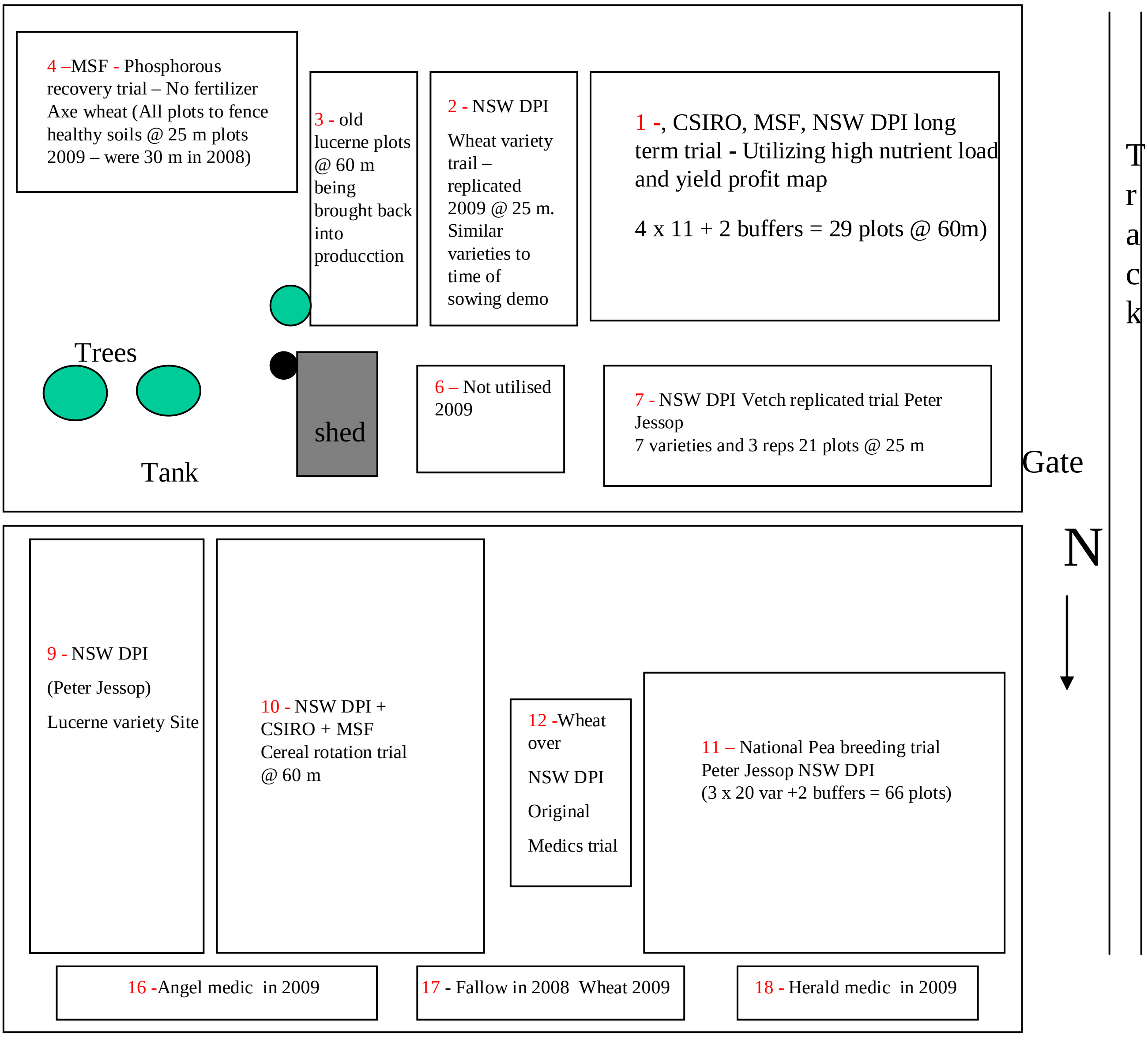
Located approximately 40 km from Mildura on the Hwy to Euston (just after the 110km speed change). Station buildings located on the right, for the trial site take the track opposite (left off the main road) and travel approx 2-3km Nth (across several stock grids) until you see a small shed and fenced area on the right.

Longitude 34˚ 16˝ 57.98˚S Latitude 142˚ 22˝ 15.24˚E



Kerribee Field Day
Thursday 27th August, 2009

TIME	TOPIC	SPEAKER
9.00	REGISTRATION	
9.30	MSF WELCOME	Jim Maynard, MSF Mike Mooney, MSF
9.40	UPDATE ON NSW STATE REFERENCE COMMITTEE	Ian Ballantyne, MSF Gary Doyle
9.50	CSIRO RESEARCH UPDATE	Bill Davoren, CSIRO
10.20	VARIETY TRIAL	Michael Moodie, MSF
10.30	AWB MARKET UPDATE	Rhonda Harmer, AWB
10.35	MORNING TEA	
10.50	VETCH TRIAL	Peter Jessop, NSW DPI
11.05	PHOSPHOROUS RECOVERY TRIAL	Sean Mason, University of Adelaide Anthony Baird, NSW DPI
11.25	CMA INCENTIVES UPDATE	Graeme McIntosh, Lower Murray Darling CMA
11.35	ADVANCES IN PRECISION AGRI-CULTURE	Nicole Dimos, SPAA
11.50	NEW PERENNIAL LEGUMES	Peter Jessop, NSW DPI
12.05	NEW RESEARCH INITIATIVES FOR KERRIBEE SITE	Michael Moodie, MSF Peter Jessop, NSW DPI Anthony Baird, NSW DPI
12.20	PEA VARIETY TRIAL	Peter Jessop, NSW DPI
12.35	AGRIVISION VARIETY TIME OF SOWING TRIAL	Mick Brady, Agrivision Kent Wooding, Agrivision
1.05 Onwards	BBQ LUNCH COURTESY OF RABOBANK	Jarrod Elston, Rabobank

Mallee Sustainable Farming Inc
NSW State Reference Committee

Mallee Sustainable Farming Inc. is managed by a Board of Management which includes two farmers elected from each state in which MSF operates. Current NSW Board Members are Jim Maynard and Tim O'Halloran. Initially, State-based reference committees (SRC) were established to strengthen direct participation from farmers in those States, in order to better direct research and extension to meet the needs of its members.

The NSW State Reference Committee has been relatively inactive over the past few years and the wind up of the South West Land Management Group (SWLMG) has provided the opportunity to reinvigorate the NSW committee.

All SWLMG members have been invited to become MSF members on a complimentary basis until 2011 in recognition of funds transferred to MSF as a result of the wind up and the similar nature of the organisations.

A number of past SWLMG members have expressed interest to reform the NSW State Reference Committee and the MSF Board is keen to support this.

The MSF Board are currently reviewing the structure and function of all the State Reference Committees and a community meeting will be held to formally convene the NSW committee and elect a Chairperson once the review is completed. All NSW members will be advised when this meeting will be held and you are encouraged to attend.

At this stage the key tasks of the state committees include

a) Providing advice and feedback on research and extension projects to the MSF Board;
b) Advising on priorities for research and extension needs for their respective state;
c) Developing an annual works plan and budget for MSF Board endorsement;
d) Nominating state representative Board nominees;
e) Assisting with the planning and participating in state based field days;
f) Providing advice and direction on the operations and activities undertaken on core demonstration sites.

Later today there will be an opportunity for you to have input into the future activities for this site as well as the broader MSF program and we encourage your participation.

Gary Doyle and Ian Ballantyne

Long term yield potential and in-season management of different Mallee soils- the Bimbie example

Anthony Whitbread, Rick Llewellyn and Bill Davoren.
CSIRO Sustainable Ecosystems, South Australia.

TAKE HOME MESSAGES

- At Bimbie, as in all of the Mallee paddocks mapped with EM38, spatial variability could be mapped effectively using EM38 and yield monitors and then zoned on the basis of soil variation
- Zones with high EM38 readings often have high levels of inherent fertility (eg. high plant available soil P and N) but due to sub-soil constraints restricting rooting depth, crop growth is typically limited by available soil moisture. Zones with low EM38 readings are typically sandy but crop growth is often limited by nutrition
- Yield expectations, decisions about input levels or in-season decisions such as topdressing N, grazing or cutting for hay, crop insurance etc. can be made more confidently by understanding the inherent risk of different soil types.

Summary
Farmers have long been aware that crop performance within paddocks shows enormous spatial variation, especially in the cropping regions of the Mallee. These differences in yield are driven predominantly by soil variation and are often as great as season to season variability. With the advent of tools to detect soil variability such as EM38, yield monitors and variable rate fertiliser spreaders, farmers are now in a position to better manage variation. Because relative yield differences between zones delineated on the basis of subsoil constraints (inferred from electromagnetic induction or EM38) are not constant, a combination of field results and modelling has been used to determine the likely longer-term economics of zone management. This paper outlines an approach where representative soils within the zones of like yield performance were characterised for their plant available water capacity (PAWC) and sub-soil chemical constraints. Crop-soil modelling tools (APSIM -Agricultural Productions Systems sIMulator) were used to simulate the potential yield of zones as well as in-season predictions of crop growth.

Materials and methods
Using the information collected in the Mallee Sustainable Farming (MSF) Reaping Rewards project, 4 sites were selected (Bimbie, Carwarp, Pinnaroo and Loxton). At each site in 2006 the sites were intensively sampled for the analysis of chemistry and texture. An EM38 survey was used to create 3 EM-based soil classifications for each paddock using an isocluster technique. The soil cores were assigned to the soil classifications in which they were located and the results presented are averages of the cores falling into these zones. In order to characterise the plant available water capacity (PAWC) of each zone, the drained upper limit (DUL) was determined at a point within each zone by wetting up soil to saturation and allowing it to drain and then measured. Crop lower limit (CLL), was also determined for each zone using the soil moisture measured at the harvest of wheat crops in 2006 (9 cores across the 3 soil classes) and in 2007 (27 cores across the 3 soil classes). The lowest soil moisture value measured in the 2 seasons was used as the CLL. Using crop modelling and the long term weather records sourced from a nearby weather station (Euston), a simulation of wheat growth in each year for the period 1957 to 2006 was undertaken with APSIM (Agricultural Productions Systems sIMulator). The simulations are reset each year so that starting soil N and organic matter remain the same in all years. Starting soil mineral N was assumed to be the same (52 kg N/ha to 110cm) for each soil class in the paddock. The effects of rainfall, evaporation, drainage and water extraction by the crops were all calculated by the model. Wheat (cv. Yitpi) was sown between April 25 and July 15 and sowing within this period was triggered by 10 mm rain over 5 days and the soil profile had to contain at least 10 mm of available soil water.

Results:
Mapping soil property boundaries
The use of EM38 to differentiate soil boundaries based on the sensing of subsoil characteristics such as clay content and salt concentration has been shown by the Reaping Rewards work as an effective method for zoning Mallee paddocks into management zones of similar yield potential. An example of this is shown for

Bimbie where the EM38 measurements correlate well with the 2006 and 2007 yield monitor data (Fig. 1). These maps provide a good example of how EM can be used to help identify areas of the paddock with differences in yield potential that can't be easily identified based just on elevation. The 2006 and 2007 seasons, where a dry finish meant that subsoil constraints were very important factors, are examples of seasons where yield maps that are unaffected by other factors such as frost, disease and weed patches can be expected to align reasonably well with EM maps. It should be noted that a strong relationship between EM zone and yield will not occur in every season-type. In 2005 for example, good rainfall throughout the growing season made the subsoil constraints and the availability of stored moisture less critical to crop yield with less yield variation across the paddock.

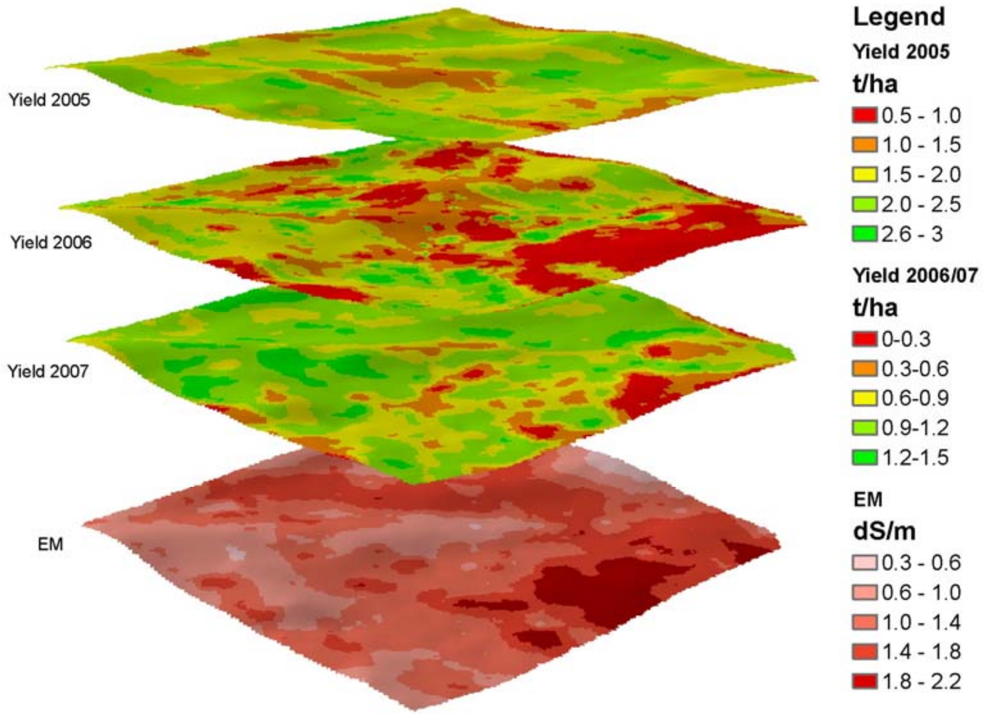


Figure 1a. Bimbie EM map, 2005, 2006 and 2007 wheat yield maps showing paddock elevation.

Representative soil characterisations for each zone-Bimbie example

Within each zone soil properties, particularly soil texture and the depth to sub-soil constraints, determine how water behaves in the soil profile and how much is available to plant uptake or evaporation. Typically sandy textured soils (usually low EM38 values) have deep profiles and no chemical sub-soil constraints. In heavier textured soils, particularly where sub soil constraints exist, the amount of water available to plants can be limited to the surface layers. Whilst the plant available water capacity may be high in these surface layers, evaporation losses are potentially much higher. By measuring the soil moisture content at the crop lower limit (CLL) and at drained upper limit (DUL) in the low EM zones (Fig 2a), we found that soil moisture content at CLL was lower than in the moderate and high EM zones (Figs. 2b and 2c), reflecting no subsoil constraints restricting the uptake of water from all layers in the soil profile. The soil moisture content at DUL was also lowest in these sandier textured soils, but usually increasing with depth with an increase in clay content. The soil moisture content at CLL of the soils in the zones with high subsoil constraints was higher at all depths in the profile than the corresponding low zone soils, and as the level of chemical constraints increased at depth soil moisture could not be extracted by roots from the profile (Figure 2c). DUL was also highest due to the increased clay context of the soils in these constrained zones.

The simulation of wheat growth over the long term.

To enable yield potential to be determined in the zones over a wide range of season types, representative soils in all paddock zones were characterized and wheat yield simulations run using the crop model APSIM. The simulated yields all the sites and seasons from 1957 to 2007 showed consistently large differences in median yield between the low or moderate zones and the high EM zones (Table 1) at all rates of sowing N. The addition of 15 or 30 kg/ha of N at sowing resulted in higher grain yields (and gross margins) in the low or moderate zones. The likelihood of achieving a worthwhile economic return ($2 return for $1 invested) was highest for zone 1 (Table 2) ranging from 60-63 %, slightly lower for the moderate zone (53% at both N rates) and poor for the high EM zone (30-35%).

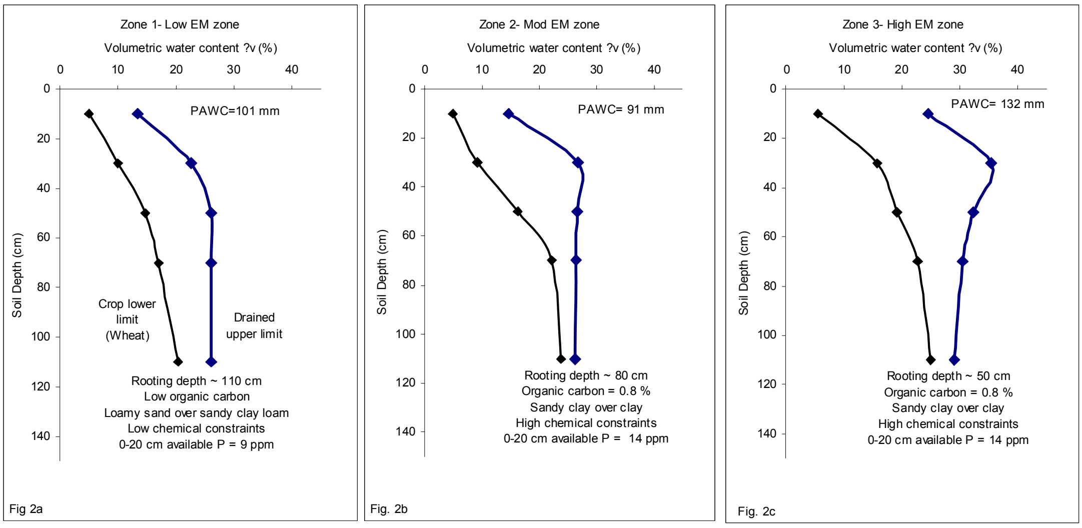


Figure 2. The characterisation of the crop lower limit (CLL) and the drained upper limit (DUL) for the Bimbie soil profiles in the zones defined as containing low (Fig. 2a), moderate (Fig. 2b) or high (Fig. 2c) subsoil chemical constraints that restrict rooting depth.

Table 1. Average yield (t/ha) and gross margin (in brackets) of wheat over 50 seasons

		N at sowing (kg/ha)		
Zone	EM	0	15	30
1	low	0.64 ($31)	0.92 ($76)	1.16 ($112)
2	moderate	0.78 ($62)	1.02 ($98)	1.21 ($123)
3	high	0.45 (-$11)	0.59 ($3)	0.68 ($7)

Note: grain valued at $220/t, fertiliser N at $1.10/kg and variable costs $110/ha.

Table 2. The percentage of seasons where the grain return from $1 spent on N is greater than $0 or $2.

Zone	0N to 15N	0N to 30N		
	>0	>2	>0	>2
1	97	63	95	60
2	88	53	84	53
3	78	35	74	30

Future Directions:
Zonal management, especially in relation to fertiliser and seed application, can be an opportunity to reduce inputs into the constrained zones and capitalise on the performance of less constrained zones by increasing inputs. The opportunities to strategically manage the zones, for example topdressing light sands in a wet year or deciding to cut/graze constrained zones at some decision point in a dry year, are management options that should be informed by facts. These facts include the stage of the crop and time of season, plant available N and water and seasonal outlook. Modelling tools, particularly Yield Prophet, can take these factors into account and provide accurate predictions of likely yield outcomes.
Where crop performance is consistently poor, alternative land uses may be more profitable and result in other benefits such as increased ground cover or better fodder reserves.

Acknowledgements:
This work is part of a CSIRO-Rural Solutions-Mallee Focus-MSF project. The findings are the result of GRDC projects "Training Growers to Manage Soil Water Project" and Reaping Rewards. The support of the participating farmers at each site is gratefully acknowledged.

Further information: Mr Bill Davoren, (Ph) 08 83038656 (Email) bill.davoren@csiro.au

Kerribee core site trial
Soil biological status after six years of various cropping systems on a Belah soil

Gupta Vadakattu[1], Bill Davoren[1], Anthony Whitbread[1], Rick Llewellyn[1], Graeme McIntosh[2] and David Roget[3]
[1]CSIRO, Waite Precinct, Adelaide; [2]NSW DPI; [3]ex-CSIRO

Key messages:

- Management of carbon (C) inputs through different rotations has a significant impact on the type of microbial community that develops in that specific farming system.
- Continuous cropping systems with adequate inputs that can provide C inputs annually and stubble retention can significantly improve microbial biomass C and nutrient (nitrogen (N) and phosphorous (P)) levels and the activities of microbial communities involved in nutrient mineralisation.
- Six years of low-input fallow-crop rotation caused a significant decline in the resilience of the microbial community probably due to the exposure to boom-bust cycles in terms of C availability.
- Organic C and total N levels in surface soils were generally higher under high input opportunity cropping systems compared to the low-input fallow-crop rotations, however the differences were small.

Aims:

- To determine the status of soil biological health after five years of intensive cropping, reduced tillage and higher fertiliser inputs compared to low-input district farming (fallow-crop) practices.

Background:

The long-term sustainability of Australian agriculture largely depends on the ability to maintain or improve the biological health of soil. Traditional fallow-crop rotations with multiple cultivations are generally characterised by short and long-term fallows with low-input and low risk strategies in which crops depend on soil fertility for plant nutrition. Fallow periods are considered beneficial to store moisture and accumulate mineral N for the use of the following grain crop. However, these farming practices have been shown to result in loss of soil fertility and increased erosion risk. Over the last ten years, research on the Mallee sands has demonstrated the production, economic and environmental benefits from intensive cropping systems when coupled with no-till and stubble retention. Such systems also require the supply of plant nutrition through external fertiliser inputs to achieve water-limited potential. Unlike the Mallee soils, Belah soils have the potential to support higher levels of N mineralisation although may be restricted by the availability of C for biological activity.

About the trial:

The Kerribee trial is located approximately 25km south east of Mildura, NSW. The trial is replicated (x 4) with 11 treatments partially phased. Plots were sown on the 27th May, 2008. Treatments are briefly outlined in **Table 1**. ‘Opportunity cropping’ rotation refers to crop choice dependent on seasonal opportunity; cereals are the main crop and alternative crops such as canola are only sown if there is sufficient soil moisture and an early break.

Table 1. *Kerribee treatments 2007*

Tmt	Rotation	Till	Input	Fertiliser	Seed Rate	2007 Crop
1	**Wheat**/Fallow	CC	DP	60kg MAP	30kg/ha	Wheat Yitpi
2	**Fallow**/Wheat	CC	DP	Fallow	Fallow	Fallow
3	**Fallow**/Wheat	**RT**	DP	Fallow	Fallow	Fallow
4	**Wheat**/Fallow	CC	Ad	75kg/ha MAP + Zn 2.5% 43 kg/ha Urea	30kg/ha	Wheat Yitpi
5	**Opportunity Crop-ping**	DD	Ad	75kg/ha MAP + Zn 2.5% 43 kg/ha Urea	30kg/ha	Wheat Yitpi
6	**Peas**/Wheat	RT	Ad	75kg/ha MAP + Zn 2.5%	**100kg/h**	Peas Kaspa
7	**Wheat**/Peas	RT	Ad	75kg/ha MAP + Zn 2.5% + 43 kg/ha Urea	30kg/ha	Wheat Yitpi
8	Cereal/**Canola**	RT	Ad	150 kg/ha SuperPhos 70 kg/ha Urea	5 kg/ha	Canola ATR Stubby
9	**Continuous Cereal**	RT	Ad	75kg/ha MAP + Zn 2.5% 43 kg/ha Urea	30kg/ha	Wheat CF Stiletto
10	**Wheat**/Fallow	DD	Ad	75kg/ha MAP + Zn 2.5% 43 kg/ha Urea	30kg/ha	Wheat Yitpi
11	**Opportunity Crop-ping**	RT	Ad	75kg/ha MAP + Zn 2.5% 43 kg/ha Urea	30kg/ha	Wheat Yitpi

CC = Conventional Cultivation, fallows commenced chemically in August then CC
RT = Reduced Tillage, chemicals commenced in August, cultivation in Feb/Mar
DD = Direct Drilled, no cultivation, single pass sowing.
DP = District Practice, 60 kg/ha MAP
Ad = Adequate, 75 kg/ha MAP + Zn and 43 kg/ha Urea.

Assessments:

Prior to the start of 2008 cropping season, surface soil samples (0-10cm) were collected from selected treatments for detailed analysis of microbial diversity and activities. Soil samples were also analysed for organic C and total N levels. Detailed monitoring and analysis of this trial by CSIRO ended in 2007.

Results:

Composition of microbial communities

Soil biota in Australian agricultural soils are generally short of available C for their growth and thus cropping systems that increase the amount of C inputs improve the populations and activities of soil biota. The quantity and quality of crop residues influence the composition and populations of various groups of microbial communities involved in nutrient cycling, disease suppression and plant growth. Composition of microbial communities plays a significant role in the different types of benefits observed due to intensive cropping and stubble retention. The composition of microbial communities was analysed in selected treatments based on their ability to use various C and N compounds (e.g. catabolic profiling), that are known to be released by plant roots and be part of crop residues. After five years of different cropping treatments at the Kerribee site, we found a significant change in the composition of microbial communities. For example, microbial communities under fallow-crop rotations were significantly different to that under high input intensive cropping treatments (**Figure 1**). These changes in microbial communities would drive the biological activities involved in nutrient mineralisation (N and P) and disease suppression. Results at the Waikerie core site also indicated significant changes in the soil microbial communities under intensive cropping treatments compared to low-input pasture crop rotations. At the Waikerie site, on a Mallee sand, microbial communities under grain legume-wheat rotation were more similar to canola-wheat rotation. The heavier Belah soil at the Kerribee site contains higher levels of total N compared to the Mallee sand which would have influenced microbial communities.

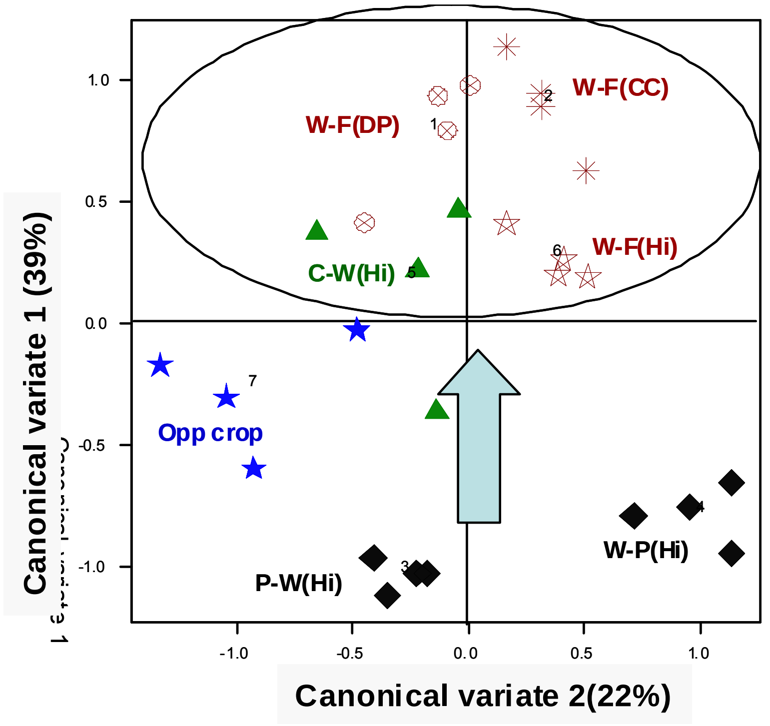


Figure. 1 *Microbial community composition after 6 years of various cropping systems at Kerribee (pre sowing 2008). Data points closer to each other means they have similar microbial communities.*

<u>Resilience of soil biological properties</u>

Australian soils are inherently low in biologically available C therefore regular C inputs are essential to maintain or improve soil biological activities. Unlike those treatments under continuous cropping and pasture-crop rotations, soil microbes under a fallow-crop rotation experience little or no inputs of C during the fallow periods. During these periods biota are dependant on soil organic matter and left over crop residues as an energy (C) source. This means microorganisms under these systems are exposed to boom-bust cycles in terms of C availability. Results in previous years indicated more than a 40% decline in the microbial biomass and activity levels following 8-12 weeks of fallow period. Results from last year's analysis indicated a significant decline in the resilience of soil microbiota under the fallow-wheat system compared to the continuous cropping system (**Figure 2**).

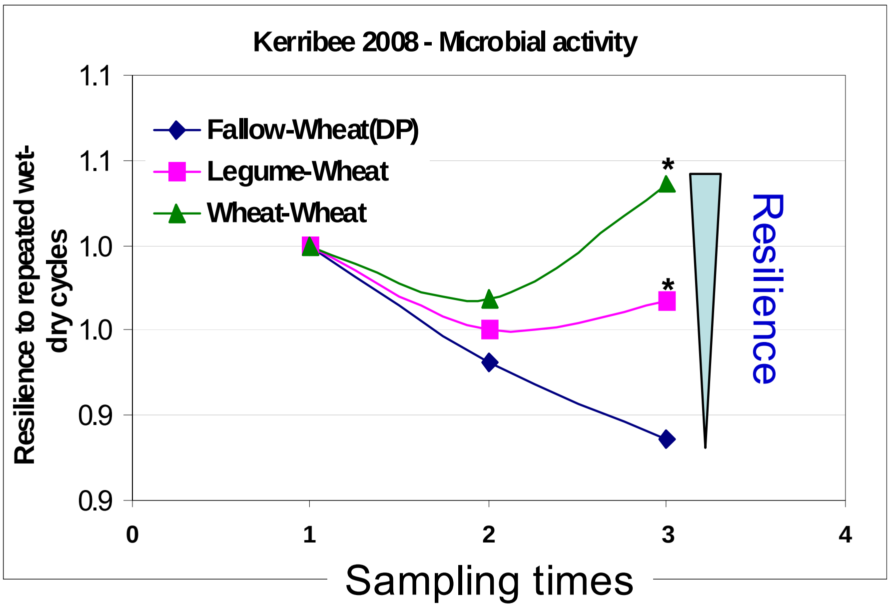


Figure 2. *Changes in the resilience in microbial activity due to intensification of cropping systems on the Belah soil at the Kerribee trial site.*

Overall, results of the analysis of soils after six years of various cropping systems, indicate that soil biota under the traditional low-input fallow-crop rotations are experiencing lack of energy (C) sources, hence may be operating below their potential. Long-term adoption of such cropping systems has the potential to cause a decline in the resilience of biota and overall soil biological health.

<u>Soil organic C and N levels</u>

Soil organic matter is an important source of C (energy) and nutrients for microbial activity. Research from other parts of Australia and overseas has indicated that management practices such as stubble retention, tillage and crop rotations (in particular pasture frequency,) can significantly influence the total C status and the size of different C pools. In general, changes in organic C and total N levels were small, although soils under the opportunity cropping treatment contained the highest levels (**Figure 3**). Results from the Waikerie site on Mallee sand indicated no increase in total organic C after eight years. Unlike the low-input fallow-wheat rotation, soils under opportunity cropping contained higher levels of organic C and total N. It is suggested that the effects of the cropping system on soil organic matter generally take a long time to be realised e.g. more than 7-10 years. In addition, the frequent occurrence of droughts during the experimental period would have resulted in lower than expected amount of C inputs from crop residues.

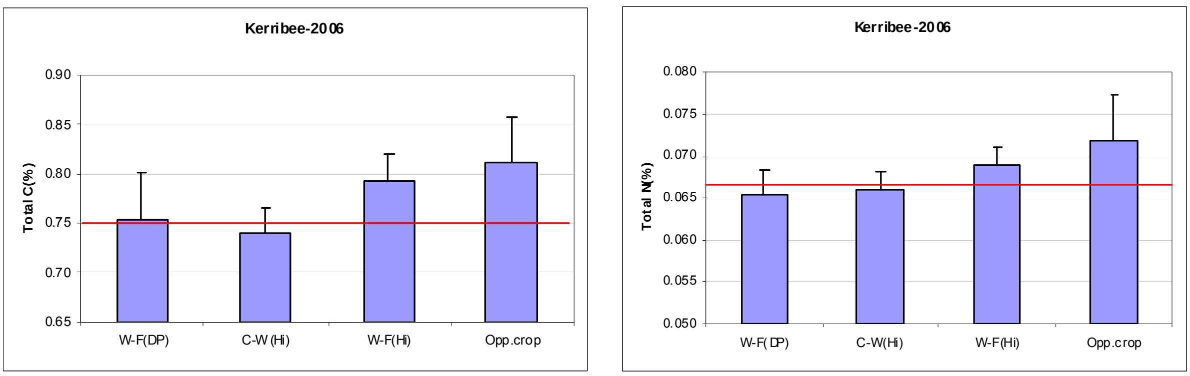


Figure 3. *Organic C and total N concentrations in surface soils after six years of various cropping treatments. (Horizontal line indicates levels at the start of trials)*

Acknowledgements:

This research was supported by the GRDC and the CSIRO Agricultural Sustainable Initiative. Microbial community analyses were performed in collaboration with the GRDC funded project – CSE00043. Special thanks to Jim Maynard and family.

Integrating new varieties into your cropping system

Michael Moodie
MSF Agronomist

Wheat varieties are being developed and released at a rate which has not been seen before, however this offers great opportunities for growers. Varieties differ in there physiological characteristics, susceptibility to pest and disease and tolerances to soil and environmental conditions. By adopting a suite of varieties, you can reduce the risk of these factors affecting your productivity.

Traditionally, crops have been sown an optimum time to avoid the risk of frost during flowering, while avoiding drought stress during crop maturity. Recently however, the risk of hot conditions during flowering and false breaks has become more important. Varieties such as Axe and Young, Peak and Derrimut have a shorter growing season and can be sown later without the yield penalties experienced when mid-long season varieties are sown late. Short season varieties are also useful to reduce the risk of dry springs. That is, when sown early, they will complete their lifecycle before the long season varieties and are therefore less reliant on good spring conditions. The downside of this strategy is that it exposes the crop to extra frost risk and early season verities performance will below the longer season varieties in good springs. Therefore, the use of shorter season varieties should be viewed as a risk management strategy and not a way of maximising productivity.

Having a wide spectrum of varieties can also spread your exposure to crop disease. For example, diseases such as stem rust can have devastating consequences, and if you are only growing varieties which are susceptible to the disease then your crop is at a high risk, or extra expense controlling the disease will be incurred if the disease does become prevalent. Diseases are also continually changing and therefore plant resistance to disease can also change from season to season.

Some growers also find it useful to rotate varieties in continues cropping situations. For example, Yitpi is very susceptible to yellow spot and the disease can build up and carry over on stubble to the next crop. Following a susceptible crop with a resistant variety such as Young can reduce the impact of the disease on the next crop.

Growers must also be prudent not to induce or reintroduce disease problems. Cereal Cyst Nematode (CCN) plagued Mallee crops until the introduction of CCN resistant varieties. Many of the new varieties do not have a high level of CCN resistance therefore if they were to dominate the rotation, CCN may again become a serious problem in Mallee crops.

Before selecting new verities to introduce to your cropping system, consider the economics of your decision. For example, assume that Yipti and Axe have the same variable costs ($150 ha). At Merrinee last season, Axe had a 21 percent yield advantage over Yitpi (Table 4). Transferring this advantage to this season, you may hope to achieve a Yitpi crop of 1 t/ha and an Axe crop of 1.21 t/ha. Yitpi is classified as an AH variety and Axe is classified as ASW. This weeks price at Ouyen is $282 t for AH and $265 t for ASW. Therefore the gross margin for Yitpi would be $132/ha and $171/ha for Axe. However Axe may have had a pronounced yield advantage last year due to the exceptionally dry spring. This year axe may only have a 10 percent yield advantage and therefore the corresponding gross margin for Axe is $141/ha. This is a gross margin advantage of only 6 percent.

The following tables have been collated from the NSW Winter Crop Variety Sowing Guide (NSW DPI), The Victorian Winter Crop Summary (Victorian DPI) and National Variety Trials Online (www.nvtonline.com.au).

Table 1. Variety Classifications and Information

Variety	Classification NSW	Notes
Yitpi	AH (Victoria)	CCN resistant and tollerent. Boron tolerant, large grain size and low screenings. Yipti has dominated the low rainfall regions of Victoria due to its higher grain yields and improved grain quality. AWB Seeds
Annuello	AH	Similar agronomically to Janz. Suitable for export and domestic markets. Intolerant to boron. ABB Seeds/PlantTech.
Correll	AH	A Yipti derivative with improved stem rust resistance, black point tolerance and *Septoria tritici* blotch resistance. Mid season, similar maturity and adaptation to Yitpi with high levels of boron tolerance. Produces lower test weights than Yitpi. AGT Seeds
Gladius	AH	Quick season maturity, similar to Diamondbird and Drysdale. Maintains relative high yields under drought stress. Boron tolerant but moderately susceptible to CCN. AGT Seeds
Derrimut	APW (Under review)	High yielding, medium to early maturity, medium to short height, Adapted to Southern NSW. AGT Seeds
Magenta		Magenta is a high yielding, mid to long season wheat variety. It has full resistance to stem and leaf rusts in WA, long coleoptile length. Crop Care Seed Technologies
Sunvale	APH	Mid season maturity. Medium straw length. High level of root lesion nematode resistance. AGT Seeds/PlantTech
Peak	AH	Medium to early maturity, medium to short height. Area of adaptation southern NSW. Crop Care Seed Technologies.
Axe	APW	Very early maturity, similar to slightly earlier than H45. Produces. Not boron tolerant. Moderately susceptible to black point. Produces very large grain with low screenings. AGT Seeds.
Young	AH	Early to Mid season variety, suitable for export and domestic markets. Resistant to CCN. ABB Seeds

Table 2. Optimum Time of Sowing for Varieties

Varitety	April				May				June				July			
Yitpi				→	☺	☺	☺	←								
Annuello				→	☺	☺	☺	←								
Correll				→	☺	☺	☺	←								
Gladius				→	☺	☺	☺	←								
Derrimut					→	→	☺	☺	☺	☺	←	←				
Magenta																
Sunvale				→	☺	☺	☺	←								
Peak					→	→	☺	☺	☺	☺	←	←				
Axe							→	→	☺	☺	☺	☺				
Young					→	→	☺	☺	☺	☺	←	←				

→ Acceptable but earlier than the ideal sowing time
☺ Ideal sowing time
← Acceptable but later than the ideal sowing time

Table 3. Variety Disease Ratings

Variety	Stem Rust	Stripe Rust (WA)	Stripe Rust (WA Yr17)	CCN Resis-tance	Yellow Spot	Septoria tritici blotch
Yitpi	S	MR-MS		MR	S-VS	MS
Annuello	R-MR	MS-S	MS-S	R	MS-S	S
Correll	MR-MS	MR-MS	MR-MS	MR	MR	MS-S
Gladius	MR-MS	R	MR-MS	MS	S	MS
Derrimut	MR	R	MS	R	MS-S	MS-S
Magenta	R	MS	MS			
Sunvale	R	R	MR		MS-S	MS
Peak	R-MR	MR-MS	MR-MS	R	MS-S	S
Axe	MS	MR	MR	S	S	MR
Young	MR-R	MR	MS	R	MR-MS	MS

VS Very Susceptible
S Susceptible
MS Moderately Susceptible
MR Moderately Resistant
R Resistant

Table 4. 2008 National Variety Trial Results for the Victorian Mallee

Nearest Town	Birchip		Hopetoun		Manangatang		Merrinee		Murrayville		Quambatook		Ultima		Woomelang	
Variety Name	t/ha	%	t/ha	%	t/ha	%	t/ha	%	t/ha	%	t/ha	%	t/ha	%	t/ha	%
Annuello	1.31	96	3.45	94	1.56	82	0.55	76	0.26	31	0.58	70	1.23	74	0.39	34
Axe	1.53	112	3.99	109	2.17	115	0.86	118	1.49	177	0.93	111	2.13	127	1.83	158
Bullet	1.49	109	4.01	109	2.2	116	0.71	98	1.28	152	0.85	101	1.77	106	1.75	151
Bumper	1.26	93	3.82	104	2.03	107	0.68	94	0.91	108	0.71	84	1.48	88	1.15	99
Catalina	1.26	92	3.55	97	2.02	107	0.71	98	0.78	93	0.86	103	1.77	106	1.26	108
Clearfield Jnz	1.31	96	3.19	87	1.51	79	0.58	80	0.32	39	0.66	78	1.3	77	0.36	31
Correll	1.35	99	3.67	100	1.82	96	0.84	116	0.79	94	0.85	101	1.62	97	1.02	88
Dakota	1.3	95	3.27	89	1.37	72	0.61	84	0.37	44	0.86	103	1.65	99	0.58	50
Derrimut	1.39	101	3.76	103	1.71	90	0.78	107	0.81	96	0.8	96	1.57	94	0.83	71
Espada	1.33	97	3.82	104	2.09	110	0.84	115	1.05	125	0.89	107	1.74	104	1.1	95
Frame	1.37	101	3.49	95	1.76	93	0.76	105	0.54	64	0.93	111	1.54	92	0.54	47
Gladius	1.42	104	3.83	105	2.04	107	0.86	118	1.05	124	0.94	113	1.87	112	1.38	119
Guardian	1.41	103	3.66	100	1.94	102	0.69	95	0.45	53	0.82	98	1.42	85	0.77	66
Janz	1.21	89	3.53	96	1.53	81	0.61	83	0.48	57	0.7	83	1.51	90	0.56	49
Lincoln	1.53	112	4	109	2.01	106	0.92	126	0.95	112	0.89	106	1.69	101	1.37	118
Magenta	1.28	94	3.62	99	1.8	95	0.77	106	0.59	70	0.82	98	1.57	94	0.74	64
Peake	1.46	107	3.71	101	1.88	99	0.82	113	0.87	103	0.96	115	1.88	112	1.21	104
Pugsley	1.34	98	3.39	92	1.72	91	0.59	81	0.59	70	0.75	89	1.44	86	0.66	57
Waagan	1.51	111	3.75	102	2.28	120	0.58	80	1.04	123	0.8	96	1.56	93	1.39	120
Wyalkatchem	1.22	89	3.61	99	2.11	111	0.62	86	0.76	90	0.67	80	1.38	83	1.28	110
Yitpi	1.35	99	3.66	100	1.97	104	0.71	97	0.73	87	0.88	106	1.61	96	1	86
Young	1.38	101	3.88	106	1.96	103	0.65	89	1.13	133	0.85	101	1.86	111	1.45	125
Site Mean (t/ha)	1.37		3.66		1.9		0.73		0.84		0.84		1.67		1.16	
CV (%)	5.12		3.83		7.52		7.82		11.32		10.56		7.78		8.76	
LSD (t/ha)	0.13	9	0.25	7	0.25	13	0.1	14	0.16	19	0.16	19	0.23	14	0.17	15

Results For Vetch & Medic Trials

Peter Jessop
Dareton

VETCH 2008

Objective: Evaluate the growth of low rainfall vetches at Kerribee in the northern mallee.

Background: 6 varieties of vetch were planted in 2008. These were a mixture of commercially available low rainfall varieties and also test lines from SARDI. The same six varieties have again been planted at the trial site in 2009.

Seeding details: Seeding rate 30kg/ha, no fertilizer or innoculant was used during this trial in consultation with SARDI. Sowing depth 3cm directly sown into fallowed ground with 18cm spaced chisel points and no press wheels.

Trial layout: 6 x 50m long plots, no replicate plots.

Results

The data (fig.1-2) showed clear differences in the growth of the 6 vetch varieties. SA34831 a variety not yet commercially released was clearly the highest producer of dry matter 3500kg/ha followed by Rasina at 2200kg/ha and Morava at 1500 kg/ha. As far as seed weights Rasina was highest 102gr/m2 followed by SA34831 95gr/m2 and then Blanchfleur 59gr/m2.

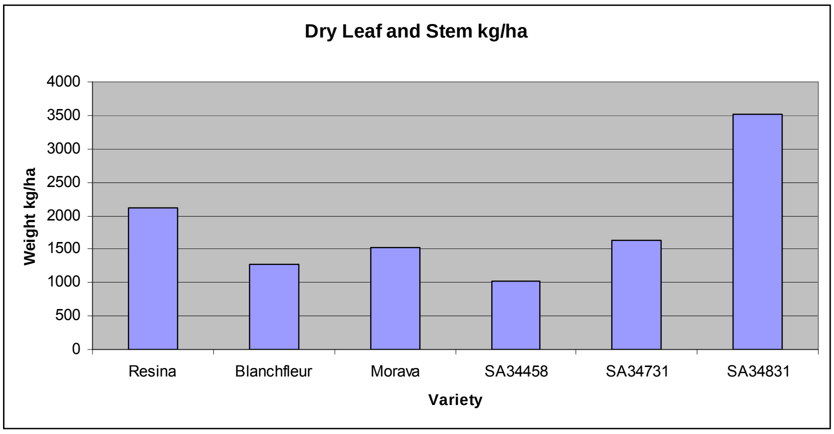


Fig. 1. Dry leaf and stem weights taken at seed harvest

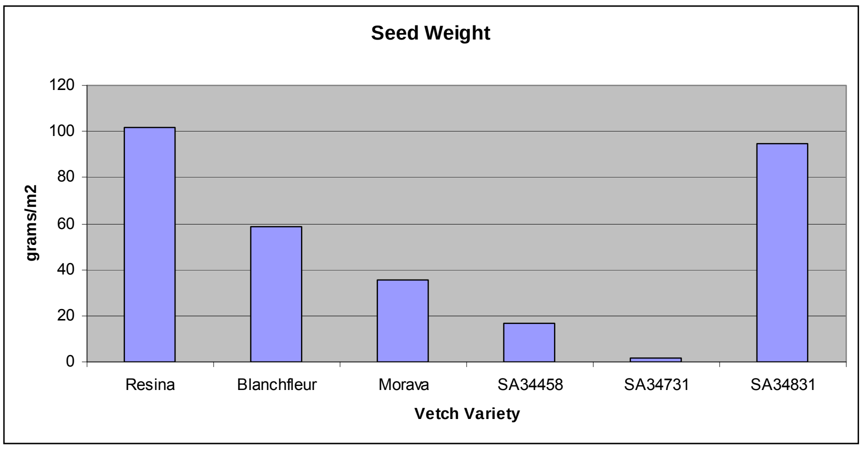


Fig. 2. Seed weights following harvest.

ANNUAL MEDICS 2005

Objective: The annual medic trial was established in 2005 to demonstrate the impact of Sulfonylurea (SU) herbicide residues on the growth of annual legumes especially medics.

Background:
Sulfonylurea (SU) herbicides such as triasulfuron (eg Logran®), chlorsulfuron and metsulfuron-methyl are used extensively in the cereal-livestock zones of temperate Australia. They are regarded by farmers as effective, cheap and safe-to-apply herbicides with useful levels of residual activity in the year of application. However these residues can persist into following years, particularly in areas with alkaline soils and low rainfall, where their breakdown by microbial action and chemical hydrolysis is significantly reduced. Regenerating pasture legumes such as annual *Medicago* spp. can be intolerant of even very low residues of SU herbicides, resulting in stunting, reduced dry matter production, lower seed yields, poor persistence and decreased N fixation.

Trial layout
One month prior to planting, triasulfuron was applied in strips at four rates (0, 1.5, 3 and 6 g/product/ha – i.e. 0, 5, 10 & 20% full label rate) in an attempt to simulate a range of residues that might be experienced by regenerating pastures after application in the cropping phase of a cereal/pasture rotation. Seven annual medic cultivars representing four species (Angel[A] and Herald[A] strand medic, *M. littoralis*; Scimitar[A] and Cavalier[A] burr medic, *M. polymorpha*; Caliph[A] and Jester[A] barrel medic, *M. truncatula* and Toreador[A] hybrid disc medic, *M. littoralis x tornata*) were compared at a seeding rate of 10kg/ha.

RESULTS
Of the plots treated with Logran Angel clearly showed (Tables 1-3) it's superior tolerance to SU residues producing higher dry matter, pod and seed production than the other cultivars in the two highest SU treatments with the exception of Jester which produced a higher seed yield in the 3g/ha plot.

In the control plots however, not treated with SU herbicide Angel and Herald strand medic, Caliph barrel medic, Jester barrel medic and Toreador hybrid disc x strand medic produced equally high amounts of dry matter kg/ha. While, Scimitar and Cavalier performed poorly. Angel produced the highest pod numbers closely followed by Toreador, Jester, Caliph, Scimitar, Herald and Cavalier. Toreador had slightly higher seed production than Angel while the other medics were a lot lower.

Table 1. Dry matter production (kg/ha) at the end of the growing season and rank

TREATMENT g/ha Logran	Angel	Herald	Toreador	Caliph	Jester	Scimitar	Cavalier
0	1200^{1}	1200^{1}	1200^{1}	1200^{1}	1200^{1}	700^{2}	550^{3}
1.5	1200^{1}	1200^{1}	1200^{1}	1200^{1}	1200^{1}	600^{2}	400^{3}
3	1200^{1}	700^{3}	900^{2}	900^{2}	700^{3}	200^{5}	450^{4}
6	1200^{1}	600^{2}	550^{3}	600^{2}	600^{2}	200^{4}	200^{4}

Table 2. Pod yield (kg/ha) and rank

TREATMENT g/ha Logran	Angel	Herald	Toreador	Caliph	Jester	Scimitar	Cavalier
0	1288^{1}	839^{6}	1229^{2}	948^{4}	1020^{3}	845^{5}	631^{7}
1.5	1085^{1}	724^{4}	944^{3}	621^{5}	951^{2}	349^{6}	164^{7}
3	973^{2}	279^{6}	483^{3}	328^{5}	1161^{1}	453^{4}	154^{7}
6	981^{1}	193^{3}	45^{5}	43^{6}	328^{2}	103^{4}	5^{7}

Table 3. Seed yield (kg/ha) and rank

TREATMENT g/ha Logran	Angel	Herald	Toreador	Caliph	Jester	Scimitar	Cavalier
0	425[2]	185[5]	430[1]	129[7]	248[4]	268[3]	174[6]
1.5	325[1]	133[4]	285[2]	117[5]	238[3]	33[6]	24[7]
3	260[2]	60[5]	108[3]	39[6]	296[1]	92[4]	30[7]
6	274[1]	22[3]	5[6]	6[5]	84[2]	16[4]	1[7]

ANNUAL POD AND DRY PLANT MATERIAL DATA 2005-2008 FOR THE ANNUAL MEDIC SU TRIAL CONTROL PLOTS.

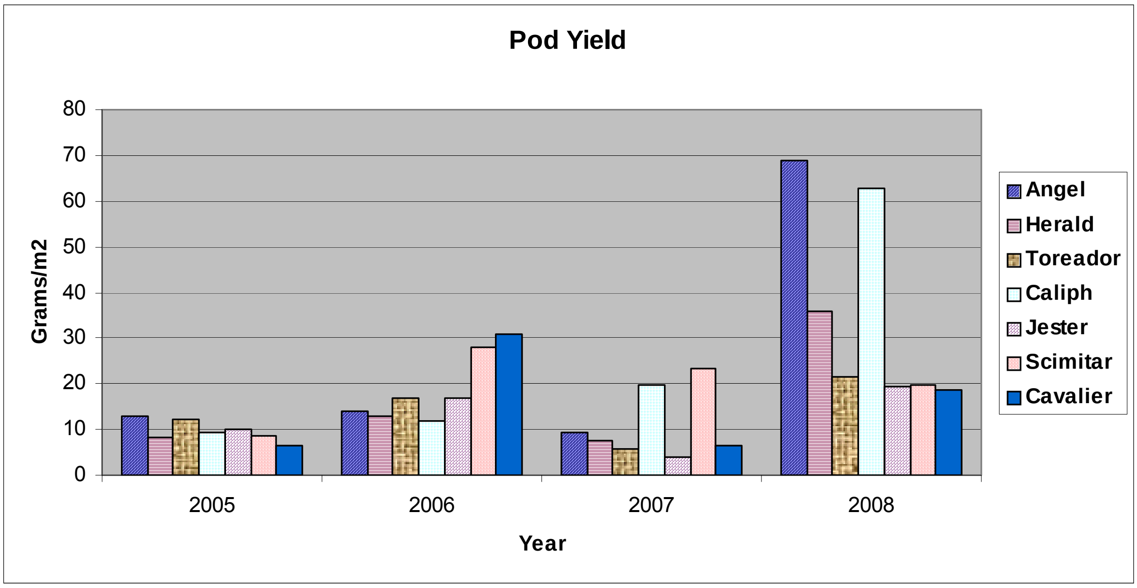


Fig.3 Pod Yield 2005-2008.

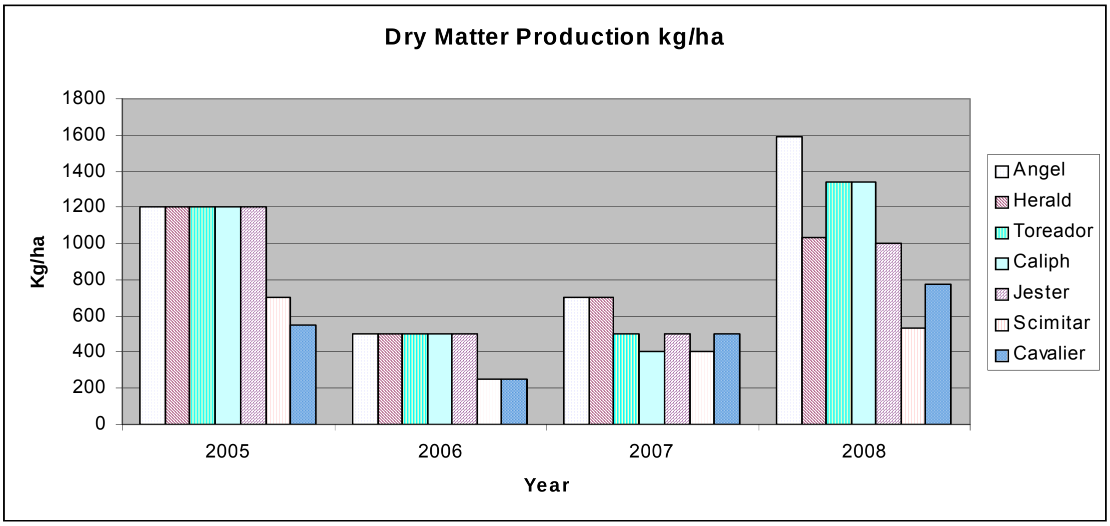


Fig. 4 Plant dry matter production 2005-2008.

CULLEN, TEDERA AND WILD LUCERNES

Until till now the majority of pasture legume breeding in Australia has focused on annuals and lucerne due to the absence of suitable perennials. However, plant breeders working with the Future Farm Industries CRC are intending to provide low to medium rainfall farmers with more perennial legume options in the near future that have amongst other traits good survivability and drought tolerance. These legumes will consist of elite lines of three very low rainfall (<200mm) perennial legume genera (*Cullen*, *Bituminaria* and *Medicago*).

Cullen is native to the semi-arid and arid regions of Australia and can grow to 2m tall depending on the species. It is a genera known for its grazing potential and survivability in the Australian rangelands and its ability to grow in various soil types.

The genus *Medicago* consists of both perennial and annual species but in this case refers to summer active wild perennial lucernes native to Central Asia. Wild lucernes are the ancestorial relatives of the lucerne cultivars we grow today but because they have not been intensively domesticated they are still genetically diverse and may therefore possess useful characteristics not present in modern cultivars.

Tedera is a native of the Canary Islands where it has traditionally been used as a forage for goats and sheep. It is reportedly extremely drought tolerant, palatable and productive even during extremely dry conditions.

Table: Approximate nutritional values

Plant	Crude Protein	Digestibility %
Tedera	15	65
Cullen	22	74
Wild Lucernes	34	76

Using DGT as a tool for making better phosphorus fertiliser decisions

Sean Mason and Annie McNeill
University of Adelaide

Background to new P test

Diffusive Gradients in Thin-Films (DGT) technology has been recently modified for the assessment of available phosphorus and micro-nutrients in Australian agricultural soils. Initial testing of the technology for prediction of wheat response to P in the glasshouse (CSO00007) and in the field (UA00095, see results below)) has clearly demonstrated the greater accuracy of DGT compared to other soil tests for assessing available P (Colwell P, Olsen P and resin). One reason for this is that the DGT test is said to mimic a plant root by only measuring the P in the soil that is accessible by the plant. Placed on top of a moist soil sample a DGT device contains a ferrihydrite (form of iron) gel which binds the P diffusing towards it. The gel is very specific for P and is free of any other element competition. After a certain time of deployment on the soil (typically 24 hours) the P bound to the gel is removed using an acidic solution and the amount of P in the eluted solution is then measured. It is these DGT deployment conditions and the use of an iron-based gel that sets it apart from other common soil P tests.

Issues associated with current soil P tests

Problems with current common soil P tests are that they use a relative small amount of soil to solution ratio and either uses an extracting solution to displace P or an anion exchange membrane to capture P in the solution. The Colwell P method is dependent on soil type and different critical values have been published for certain types of soil. In addition the method uses an extracting ion (bicarbonate) to assess the 'available P' fraction from the soil. In some cases the extracting solution can solubilise relatively stable forms of P and hence overestimate the plant available P fraction. As an example on calcareous soils the Colwell P can overestimate P availability by solubilising a portion of the unavailable P tied up with the high percentage of calcium in the soil. It has been suggested that for more reliable results on various soil types, Colwell measurements can be combined with the P buffering index (PBI) of the soil. However, in this recent work funded by GRDC (UA00095), using PBI measurements from the field trial soils did not decrease the uncertainty involved with the Colwell P method.

Soil test performance with field trials

The new soil P test (DGT) performance in predicting wheat responses to an application of P was compared to Colwell P and resin P in 22 field trials conducted in the 2007-08 growing season. Locations of trials were as follows, W.A. (1 site), S.A. (5), VIC (7), NSW (8) and QLD (1). Relationships between crop response (early DM and grain) expressed as % relative yield (% of control yield (0P) to the maximum yield obtain with P) with DGT and Colwell P are shown in figure 1. The DGT method provided an excellent prediction of wheat responses to P at both growth stages. Colwell P as a single test was shown to be a poor predictor of wheat response to P on varying soil types as indicated by the poor relationship with % relative yield. Using the method of Moody 2007 to correct Colwell P with PBI for this set of field trial data resulted in a correct prediction of crop response in only 39% of trial sites. By using the deficiency threshold (intercept of DGT curve with 90% relative yield) obtained, the DGT method correctly predicted the response for 95 % of the field trials.
An interesting observation from this data set was that several P deficient sites as indicated by early dry matter responses had either a reduced grain response or no significant grain response to an ap-

plication of P. The critical P deficiency threshold for grain identified from DGT P is therefore considerably lower than that obtained for earlier growth stages. It appears that whilst P is important in early crop growth stages it may set up a yield potential that simply cannot be fulfilled if there is insufficient moisture available during the later stages. Another scenario is that a grain response will only be obtained if the P deficiency is severe enough to affect the main crop tillers that contribute the bulk of the grain. Further studies of grain P response in seasons with more favourable finishes are needed to determine if this scenario holds in which the current project will hopefully address.

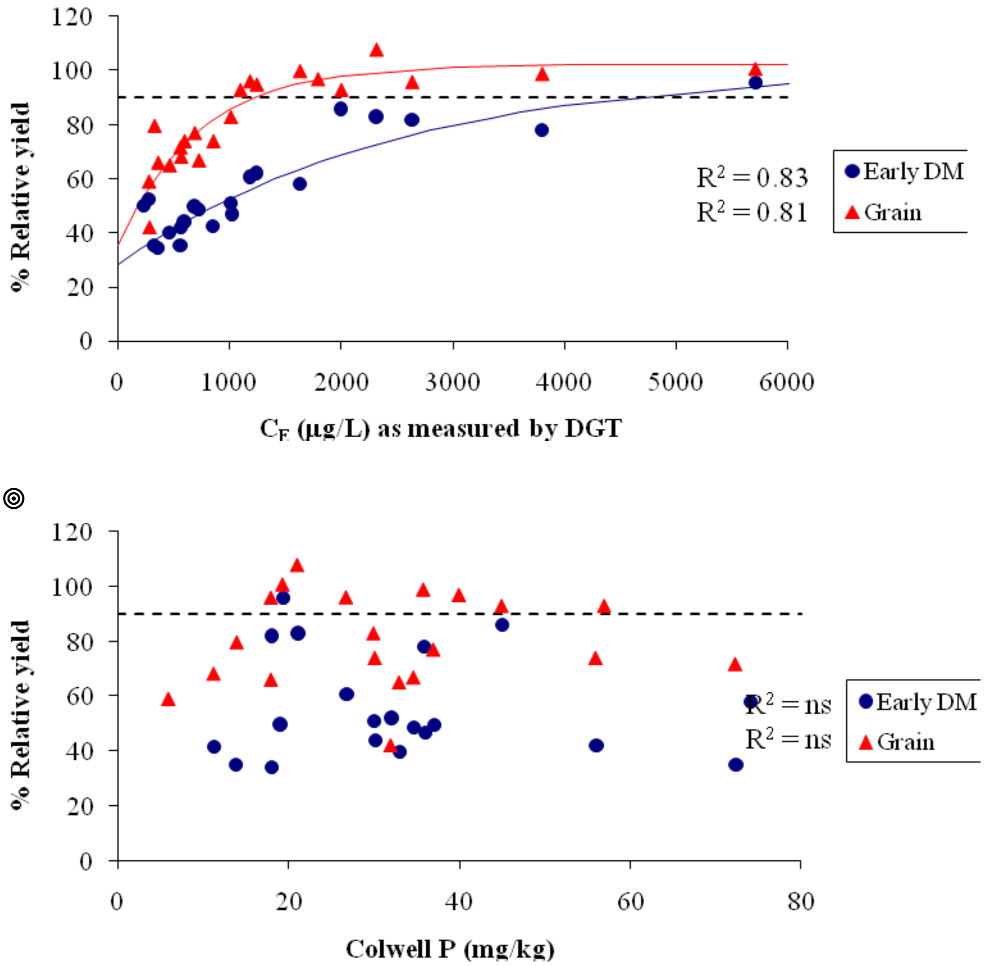


Figure 1. Relationship between crop dry matter yields taken at mid-late tillering and grain yields (expressed as % relative DM yield) with soil available P test value measured using a) DGT and b) Colwell P.

Critical P deficiency thresholds for different crop types

The validation of the DGT test so far has mainly focused on assessing the response of wheat to an application of P. Other crop types will have different capabilities for accessing and mobilising P in soil due to variations in root morphology, distribution and function and therefore will have varying phosphorus requirements. In 2008 work on the validation of the DGT test has expanded to assess other crop types and their P requirements with respect to available P in soil as assessed by DGT. Relationships of early dry matter responses of three other crops (peas, canola and barley) with DGT measurements look promising for determining the critical thresholds of these crop types (Figure 2). The order of critical P deficiency thresholds appear to be peas < canola < barley < wheat. The database for these crop types is currently small but will be enlarged with data from future growing seasons. Reliable assessment of the P requirements of these crops will provide the farmer with valuable information in order to maximise P fertiliser efficiency and help to develop a crop rotation plan that will maximise yields on a paddock basis.

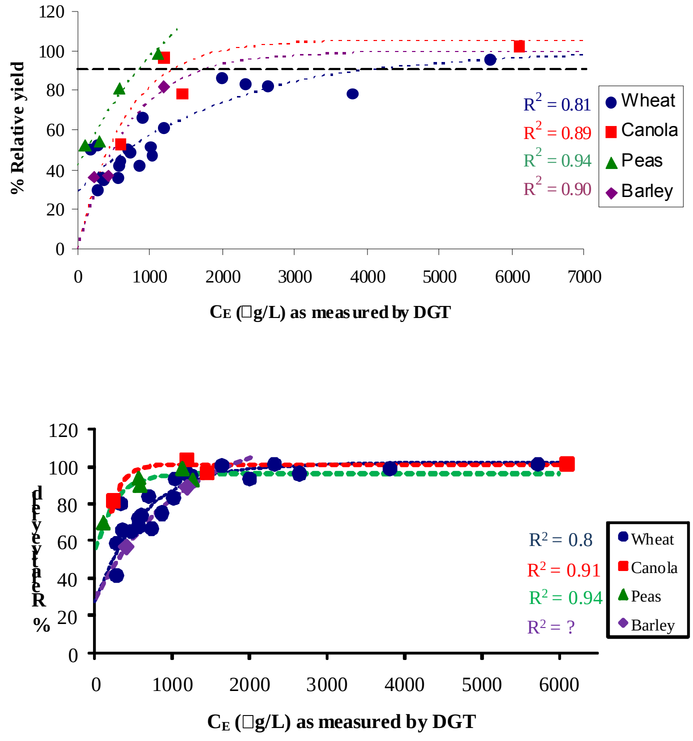


Figure 2. Relationship between a) crop dry matter yields and b) crop grain yields of four different crops (expressed as % relative DM yield) with DGT.

Using DGT and PBI to predict fertiliser requirements

Accurate and reliable knowledge of the amount of available P in a given soil is critical to fertiliser decisions such as determining whether it will be safe to reduce the amount of P fertiliser applied in a given year. However the measurement of available P in a soil sample does not provide any indication of how much P fertiliser will be available once it is applied to a soil. The Phosphorus Buffering Index (PBI) provides an indication of this and together with an accurate soil test (DGT) will help improve fertiliser recommendations.

At the moment Colwell P as shown above may be difficult to interpret on certain soil types so it is recommended that PBI is incorporated into soil testing programs. As a guide soils with PBI values below 50 will have high fertiliser efficiencies i.e. P from the fertiliser should stay in solution and be available for plant uptake. Soils with PBI values up to 100 should have moderate fertiliser efficiency and soils with PBI values greater than 200 will have higher fertiliser fixation and may require higher inputs of fertilisers. As the PBI measurement is a guide to the amount of P sorption sites on the soil the PBI value will be influenced by fertiliser history and soil type. Different fertiliser types with contrasting P efficiency (e.g. liquid vs granular) will also affect the amount of P fertiliser required to maximise yields.

Control stripping in a paddock (zero fertiliser for a seeders run) can be a useful guide to 1) the available P levels in each paddock and 2) the optimum rate of fertiliser if more than one rate is tested. Visual assessments throughout the year and yield monitors to obtain grain responses can verify if current fertiliser rates are sufficient.

Acknowledgements

The authors would like to acknowledge collaborators who have contributed to this project. They include Sandford Gleddie, Rob Velthuis (Novozymes), Simon Craig (BCG), Mark Conyers (DPI, NSW), Bill Bowden (Ag W.A.), Matt McCallum and Sam Holmes.

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GRDC Research Code: UA00095

Advances in Precision Agriculture
What are the options?

Nicole Dimos
SPAA Project Officer

What is Precision Agriculture (PA)?

"An integrated information- and production-based farming system that is designed to increase long term, site-specific and whole farm production efficiency, productivity and profitability while minimising unintended impacts on wildlife and the environment". (US House of Representatives)

While PA is familiar in cropping industries it is important to remember that precision agriculture can relate to any agricultural production system.

In addition; PA can be further defined as **Site-Specific Crop Management (SSCM)**

"A form of PA whereby decisions on resource application and agronomic practices are improved to better match soil and crop requirements as they vary in the field"

This definition encompasses the idea that PA is an evolving management strategy. From an Australian grains perspective this definition provides a defined goal regardless of a grower's current adoption of PA or proposed entry level into PA. To further expand this concept, SSCM can be considered as the application of information technologies, together with production experience, to:

- optimise production efficiency
- optimise quality
- minimise environmental impact
- minimise risk

All at the site-specific level.

The Benefits of PA

- Overcoming potential problems
- Differential management: treatment options include:

    a) Variable rate of inputs
    b) Variable type or mix of inputs
    c) Variable placement
    d) Variable timing of inputs

- Potential management classes
- Environmental gains
-

Agricultural Uses for GPS

Global Navigation Satellite Systems (GNSS) are becoming everywhere in farm management and NAVSTAR GPS receivers are by far the most common PA technology being adopted on-farm. Farmers can calculate and appreciate these benefits and therefore are quick to adopt them. While guidance/autosteer is driving GPS adoption, receivers can be used for a variety of purposes.

Table 1. The possible applications for different GPS receiver operation modes in PA.

	Standalone GPS	DGPS (C/A code)	DGPS (single carrier phase)	Dual Carrier Phase RTK (Own Base Stn)
Soil & Tissue Tests	3	3	3	3
Crop Scouting	3	3	3	3
Fertiliser Strips	3	3	3	3
Strategic Trials	3	3	3	3
Yield Mapping	3	3	3	3
Variable-rate Control	3	3	3	3
Guidance	7	3	3	3
Auto-Steer	7	7	7	3

GPS-Based Vehicle Navigation Systems

Guidance systems

- The control of the machinery remains with the operator.
- It is the operator's responsibility to ensure that the machinery is steering in the intended direction.
- The guidance system uses a signalling device prompt the diver to maintain a predetermined path.
- As such the operator can use personal judgement to override/correct any perceived errors associated with poor GPS positioning.
- Sub-metre accuracy DGPS is often utilised in this form of vehicle navigation assistance.

Autosteer systems

- These remove the operator from the majority of steering operations.
- At present these systems require manual assistance at the end of each 'run' to direct the vehicle towards the beginning of the next 'run'.
- For safety most autosteer systems have an automatic override system as soon as the operator takes control of the steering wheel.
- They also monitor the quality of the GPS signal and the autosteer will disengage (or not engage) if the GPS data is not of significant quality.

Autosteer systems can be divided into 2 categories:

a) Steering assist: This is interim level between guidance and integrated autosteer systems. Assisted steering systems have some attachment to the steering wheel which allows the machine to be steered by manipulating the steering wheel. These systems are potentially less accurate than integrated autosteer systems given the nature of the steering control.

b) Integrated autosteer: The desired track information is passed directly to the vehicle's steering system through electronic control of in-line hydraulic valves. These systems require a steering kit to be fitted to each vehicle (unless it has been factory-fitted) to allow communication/response between the autosteer computer and the hydraulic system. Using an RTK GPS with integrated autosteer is considered the most accurate option at present.

What benefits can vehicle navigation systems bring?

The gains from guidance/autosteer are related to the accuracy of the system being used and the management and quality of the driving that took place before installation. The main benefits that can be achieved are:

- Reduce skip and overlap of inputs
- Improved timeliness
- Reduced driver fatigue
- Modifications to labour requirements
- Reduce compaction
- Improved soil water management
- Increased yield
- Precise seed-bed manipulation (e.g. raised beds)
- Between-row cultivation/spraying
- Between-row planting

Considerations when purchasing guidance/autosteer

These points should be considered when contemplating the purchase of a vehicle navigation system within a certain class of operation:

- Compatibility of systems with existing machinery
- Transferability between machines
- Can the equipment be upgraded
- What software is required
- Availability of after sales support services available.
- On-going costs particularly DGPS subscription fees
- Ease of use
- Diversity of swathing options
- Signal tracking quality

What Other PA tools exist?
Various Hardware for Different PA activities

Yield monitors

- A grain yield monitoring system includes a grain flow sensor, grain elevator speed sensor, grain moisture sensor, harvester speed sensor and a comb up/down sensor. All hooked up to a global navigation satellite system.
- Yield can be calculated each second along the harvest path.
- Yield monitors need to be calibrated properly to be most effective. Calibration should be performed for each type of grain at the beginning of the harvest season. Calibrations should be checked during harvest.
- The accuracy of yield mapping is affected by various factors including incorrect installation of sensors, incorrect yield monitor calibration, incorrect harvester set-up, and poor harvesting techniques.

Quality monitors

- Crop quality may be as important as crop yield in determining profitability, particularly in higher value specialty crops such as durum wheat and malting barley.
- On-harvester grain quality sensors are relatively new (released in 2004 in Australia) and use near infrared spectroscopy (NIRS) to estimate the protein, oil and moisture content of the grain.
- Maps of grain quality can be used to identify areas where nutrient or soil management may need to be changed or provide information to separate harvested grain for sale.

Soil and terrain sensing technology

- Apparent soil electrical conductivity (ECa) is the most commonly measured soil property by on-the-go systems. This is commonly performed using an EM38 unit.
- ECa is controlled by the soil texture (i.e. the amount of clay), the type of clay, the soil moisture content and the amount of nutrients or salts in the soil water.
- The soil ECa can be generally used to estimate yield potential, subsoil constraints or salinity.
- High resolution GNSS (e.g. RTK-GPS) are able to provide an accurate map of elevation across a field

which gives information about how water moves around the landscape along with changes in the aspect of the crop relative to the path of the sun.

Remote sensing

- Uses sensors mounted on aeroplanes or satellites to gather information about soil and crops.
- Most common use in PA is to collect an image of a crop to assess the amount and quality of plant growth.
- The detail in the image depends on the altitude and type of sensor being used.

Variable-rate technology

- Variable-Rate Technology (VRT) provides a way of changing input rates as vehicles move through a field. Inputs that may be variably applied include fertiliser, lime, gypsum, chemical pesticide (herbicide/insecticide/fungicide), seed, and irrigation water.
- Variable-rate application of inputs can be controlled from predefined prescription maps or real-time crop or soil sensors.
- Variable-rate systems require:
- GNSS to locate rates on a map or map what was actually applied
- a variable gear-box, actuator, servo valve or injection pump that controls the output quantity of the application equipment
- a variable-rate controller that drives the gear box/actuator/valve/pump
- a computer that supplies the correct rates to the controller.
- In some systems, the above two are combined.
- Calibration of application implements is still essential

Crop canopy and weed reflectance sensors

- Canopy sensors are generally used to estimate the crop biomass and vigour during the growing season. This is now being used to control the application of nitrogen fertilisers.
- These sensors can also be used to map weed patches where the extra biomass in young, well established crop are weeds. These identified weed patches can be targeted with extra chemicals to help control, or a higher seeding rate into weed patches to maximise crop competition against the weeds.
- The same technology can be used at present to detect the presence and location of green weeds in fallow fields and target herbicide sprays.

About Us

- SPAA is a non-profit and independent membership based group formed in 2002 to promote the development and adoption of precision agriculture (PA) technologies.
- The association aims to be the leading advocate for PA in Australia and through this role improve the profitability and sustainability of agricultural production systems via the adoption of PA.
- PA management offers many Australian farms the potential for a quantum increase in production efficiency.
- Our mission is to facilitate research, extension and the adoption of PA.
- Current SPAA members include those involved in the production of grains, winegrapes and horticultural crops, including growers, consultants, equipment manufacturers, contractors and researchers. SPAA's wide membership base is a reflection of the potential that is offered by PA.
- SPAA has an Australia-wide focus and this is achieved by partnering with other organisations and becoming part of national and industry alliances.

See me for a membership form, and more information about SPAA, Precision Agriculture and being part of our program.

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Summary of the GRDC funded Water Use Efficiency Project 2009-2013

Anthony Whitbread and Bill Davoren
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Background:
Over the past 10 years, a major aim of the GRDC funded work done by MSF and its partners has developed and demonstrated highly water use efficient intensive cropping systems. This has led to large increases in the adoption of more intensive cereal production. There still remain many opportunities to improve average whole-farm water use efficiency (WUE) across the Mallee region. This involves addressing challenges to the WUE intensive cropping systems that has now been used by many Mallee growers over several seasons (e.g. grass weed problems, disease, high fertiliser costs, need to reduce exposure to downside risk – all factors that pose a threat to current levels of WUE), and recognizing the importance of variability in Mallee farming systems. This variability includes: 1. managing the variability in Mallee soils in a way that improves and sustains whole-farm water use efficiency; 2. managing variability in seasons and the associated risk using water use-efficient options; and 3. recognizing the diversity in farmer preference for different farming systems, including those who choose not to pursue higher-risk high-input cropping programs.

The new phase of work continues the emphasis on field experimentation by implementing core site trials at Karoonda and Ouyen as well as utilising crop-soil modelling to test the results over a range of soils and seasons.

The objectives of the project are to:

1. Identify smart breaks and phases for multiple rotation benefits: Evaluate and demonstrate the short and longer-term benefits of more diverse and flexible rotation options (e.g. grazed crops, short season crops, green/brown manures, pasture options, other 'break' options)

2. Identify when and where it is best to make use of rainfall when it falls and/or store soil water: Identify soil and climatic combinations where rainfall conservation and storage strategies (e.g. fallows) are optimal and when they are not. Other opportunities may include optimal varieties, dry seeding, and alternatives to crops solely for grain.

3. Determine 'best bet' management for soil potential: By recognising the very high level of within-paddock soil and WUE variability, identify where inputs (and cropping) can be profitably reduced (or increased) based on season-reactive and strategic approaches over a long-term range of season-types.

4. Wider weed management options: Increase diversity of current and future weed management options. (Incorporates objective 1 and collaborative projects with BCG and Uni of A).

In 2009, the Karoonda trials have been established. The technologies tested in the 'Reaping Rewards' project, EM38 and soil testing have been used to locate the new 'Continuous Systems for Soils' trials and break crop trials across a dune-swale (see map). A site has been selected at Ouyen and preliminary soil work will be undertaken this year with trials to be established in 2010 by Vic DPI.

Break Crops Trials: Three separate trials located on different 'zones' within the paddock, heavy flat, mid-slope and sand hill (established May 15 2009)

Treatments	Crop/Variety	kg/ha	Fertiliser
Legume	Peas- Kaspa	100	DAP + Zn 2% @ 50 kg/ha
Brassica	Mustard- Sahara	5	DAP + Zn @ 50 kg/ha plus Urea 35 kg/ha
Cereal – grain	Cereal rye- Bevy	80	DAP + Zn @ 50 kg/ha plus Urea 35 kg/ha
Cereal – hay/grazing	Cereal rye- Bevy	80	DAP + Zn @ 50 kg/ha plus Urea 35 kg/ha
Volunteer pasture	Volunteer Pasture	nil	Nil
Wheat (x 6)	Wheat- Correll	70	DAP + Zn @ 50 kg/ha plus Urea 35 kg/ha

Fertiliser Rate/Seasonal responsive trial: Three separate trials located on different 'zones' within the paddock, heavy flat, mid-slope and sand hill. All sown with Wheat, Variety Axe at 70 kg/ha. (established June 12 2009)

Treatments	Fertiliser	N kg/ha	P kg/ha
Low input	DAP @ 25 kg/ha	4.5	5
Low at sowing - top dress	DAP @ 25 kg/ha + Top dress N later	4.5 + (23)	5
Adequate input	DAP @ 25 kg/ha + Urea 50 kg/ha	27.5	5
High P	DAP @ 25 kg/ha + 50 kg Urea and 72 kg Triphos	27.5	20

WUE spatial trial (long plots): plots extend from heavy soil in a swale up a hill onto a deep sandy hill. Soil attributes and crop performance will be monitored across the landscape in this first year and possible treatments discussed with growers for future seasons. Some potential treatments include variable rate, season reactive (top dressing / hay cutting), opportunistic break crops, fodder, fallow (established May 15 2009)

Treatments	Crop/Variety	kg/ha	Fertiliser
Volunteer pasture	Volunteer pasture	nil	Nil
Wheat (x7)	Wheat- Correll	70	DAP + Zn @ 50 kg/ha plus Urea 35 kg/ha

Yield differences between early and late time of sowing with different varieties

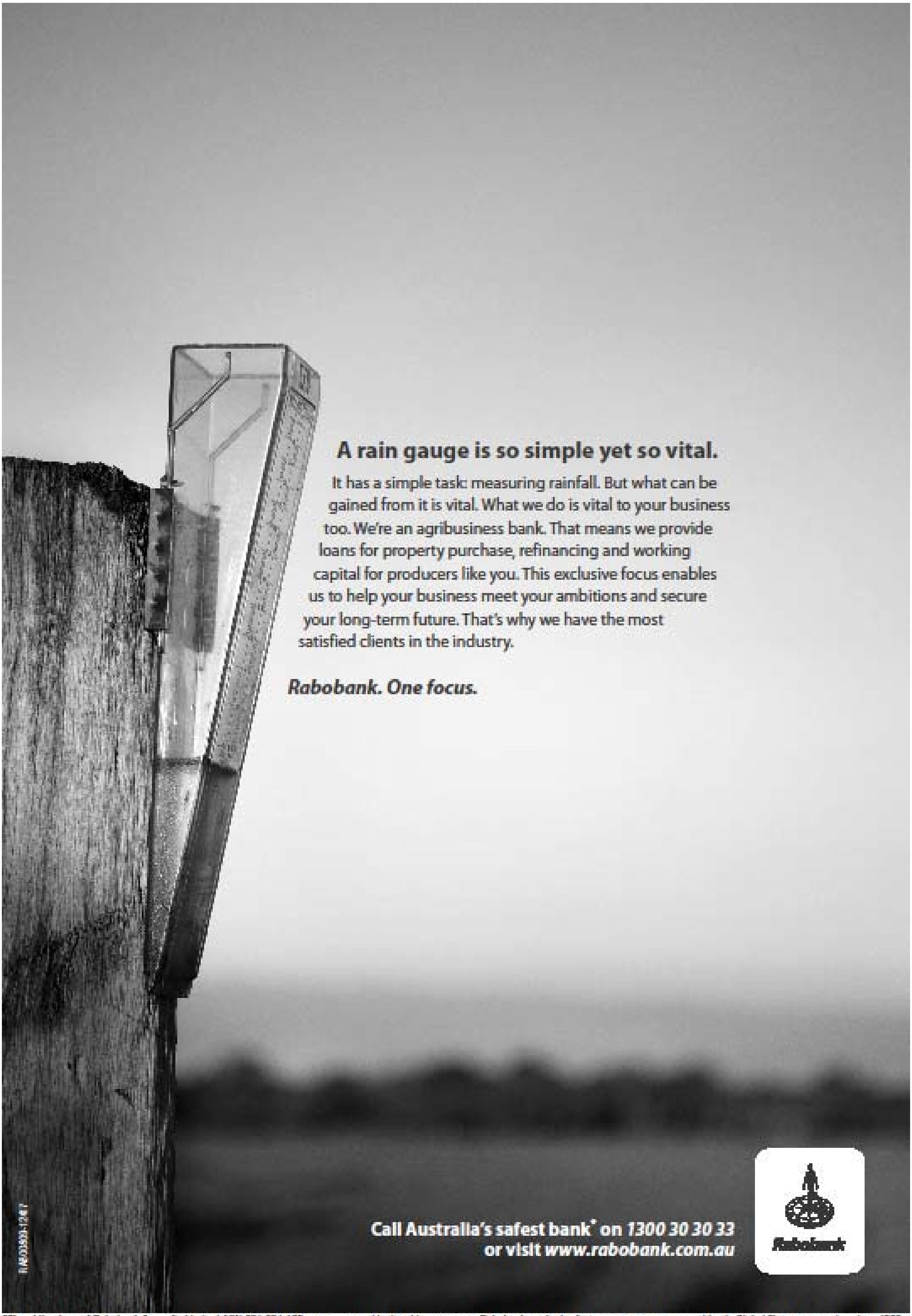
Mick Brady and Kent Wooding
Agrivision

Why do the trial?

The aim of this trial is to demonstrate to farmers the yield differences when sowing cereal crops early in the season compared to later. Different varieties of wheat and barley are used to show the differences between the varieties in the Mildura-Euston area (Kerribee Station).

How was it done?

Trial site was chosen at Kerribee Station based around the MSF/DPI trial site. The 1st sowing date was on the 7th of May and the 2nd sowing date was on the 20th of July. There were 4 barley varieties (Hindmarsh, Sloop SA, Fleet and Barque) and 6 wheat varieties (Gladius, Correl, Derrimut, Young, Drysdale and Yitpi). 1.2 L/Ha of PowerMax and 1.5 L/Ha of Triflurin were used for Pre-emergent, all sowing rates were based on 40kg/Ha and Mega Easy @ 50kg/Ha. Seed treatment on seed were Dividend @ 1.3L/ha plus BSN @ 5L/ha. All crops have received Easy N @ 15L/Ha and Zinc Sulphate @ 1 L/ha. All trial plots were sown by James Maynard's Hardwood Bagshaw bar and box with 12" press wheels.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