Precision Ag Trials

Nitrogen type and timing

Paringa-Murtho, South Australia

Although PA tools have been available to Australian grain growers for many years, and the benefits have been well documented, it is estimated that less than 1-% of grain growers utilise PA 'beyond guidance' in any form.

The objective of this GRDC / SPAA funded project is to increase the level of adoption of PA 'beyond guidance' by broadacre farmers. The project specifically aims to increase the level of adoption of variable rate (VR) by growers in the project to 30% by 2013. This goal will be achieved by demonstrating how to use PA tools to growers at a regional level and by increasing the skills of growers and industry in PA to a level where they can then use PA tools in their farming systems to achieve economic, environmental and social benefits.

Trials and demonstrations are conducted on growers' properties and are visited throughout the season using farm walks and workshops to discuss the advantages and disadvantages of PA techniques with the involvement of other regional growers.

This information sheet presents the outcomes of the SPAA trial Precision Ag, Paringa-Murtho from season 2011.

Aims:

- To encourage Mark Stoeckel, Paringa-Murtho grain grower, to experiment with different rates and types of Nitrogen fertiliser on his paddock.
- To use precision yield mapping to provide an accurate analysis of the trial.
- To demonstrate potential benefits of Precision Agriculture technologies, especially Variable Rate to demonstrate reduced risk and maximised return in continuous cropping systems.
- To demonstrate and extend the benefits of precision agriculture technology to SA Mallee growers.

Background:

Paringa-Murtho cereal grower, Mark Stoeckel, was keen to trial different timings and types of Nitrogen fertiliser and determine any yield impact in his Belah type country. Mark was also wanting to calculate the economic impacts of these Nitrogen treatments and the ultimately evaluate the potential for Nitrogen in a PA situation. Together with Rural Solutions SA Mark has been experimenting on his farm in order to help understand what is driving the production in his paddock.

'Lindsey' is a 107 ha parcel of gently undulating Belah-type country. Lindsey runs SW to NE (see figure 1 below). Surface texture over most of the paddock is sandy loam but soil depth and sub soil textures vary from light sandy clay loam to medium clay increasing the soil holding capacity of the soils. The paddock is relatively flat in the SW half of the paddock and drops in elevation in the remaining half and has a 'harder' flat at the NE estreme. However, estimated unavailable water level increase as constraints to plant growth such as sodicity, salinity, high pH and boron begin to appear in the sub soils in the lower mid-slope and increase in the flat.

From 2011 we had the following information about the paddock:

- EM38 soil data

In 2011 we produced

- Wheat yield map of paddock
- Yield analysis of treatments by paddock EM38 zone

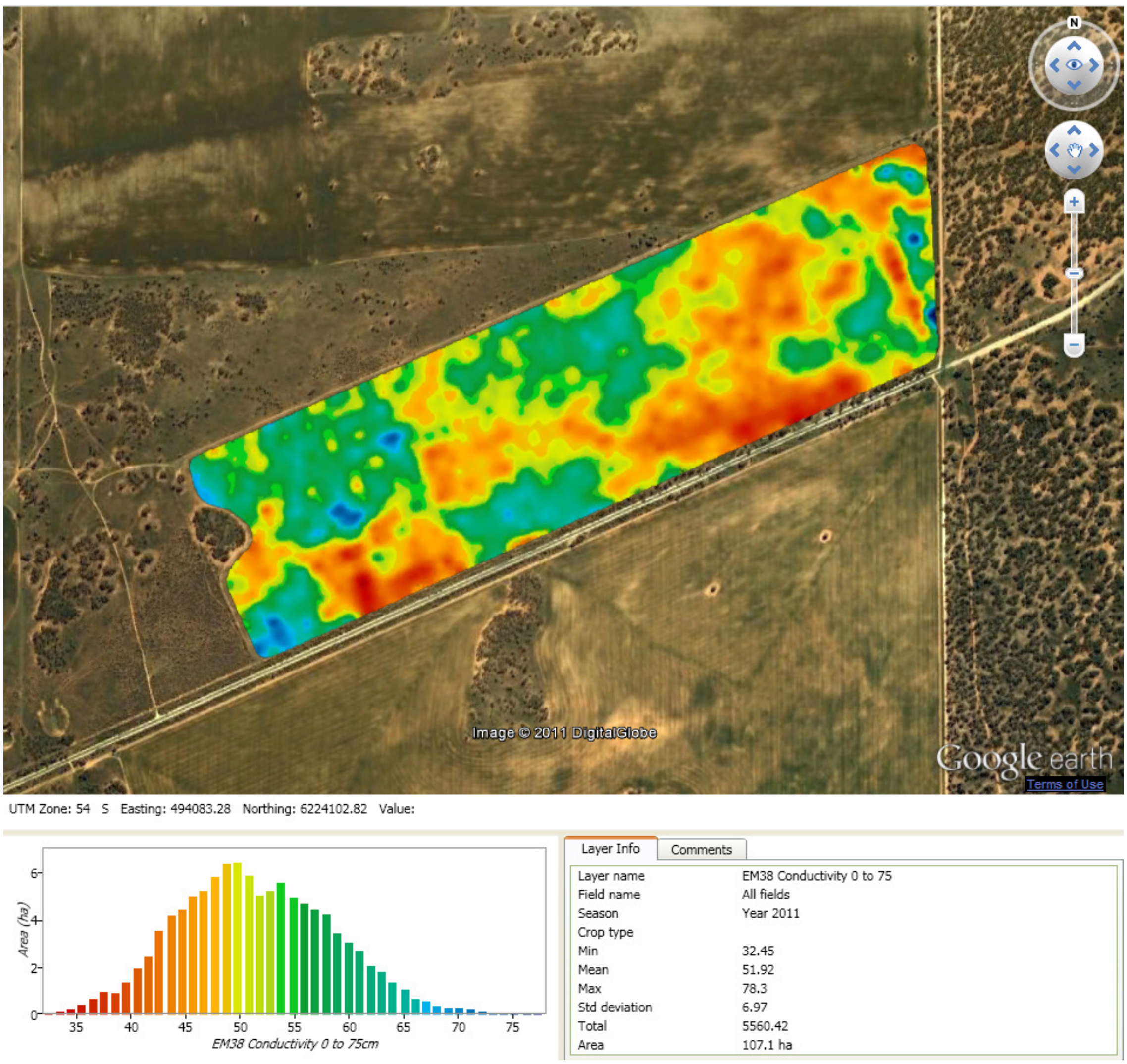

Figure 1 EM38 conductivity to 75 cm in ‘Lindsey’ paddock on SA Vic border near Paringa Murtho. Survey conducted by Peter Treloar, Vision Ag, and produced using Vision Ag Gateway software and Google Earth.

Table 1 Grain yield (t/ha) for four treatments and two reps. Grain yield is from the harvester yield monitor for each strip. Treatments were sown SW to NE on 26th May 2011. Dates for post treatments (Urea - 16 August, SOA – 2 August).

Variety	Trt #	Treat 1	Treat 2	Fert rate Treat 1	Fert rate Treat 2	Trt Yield
Correll	1	DAP	0 N	60	0	1.708
Correll	2	DAP+N	0 N	70	0	1.763
Correll	3	DAP+N	SOA	70	80	1.713
Correll	4	DAP+N	Urea	70	80	1.609
Mean						1.698
Lsd (P<0.05)						NS
CV %						3.9
P (0.05)						0.306

Table 2 Grain yield for trial treatment by three EM38 zones. Grain yield for treatment by zone determined from paddock yield map.

Assessments: Grain yield and grain quality (Screenings, Protein, and Test weight)

Results:

Grain yield was recorded continuously during harvest and logged against GPS position. From the resultant yield map it was possible to isolate treatment strips and EM38 zones within these strips and determine the yield for individual strips and therefore treatments, and also where these treatments intersect with the paddock zones. Trial was statistically analysed and Table 1 above shows there was no significant difference between treatments.

Discussion

It can readily be seen in Table 2 that while there were strong treatment effects the effect of the paddock zones on grain yield was also very strong. This is also apparent in a number of other precision ag. trials we have analysed, and growers would know and understand that various parts of a paddock respond differently in different seasons. Because of the limitations of machinery and technology up to this point growers have largely had to treat paddocks as one unit in the one operation. Other options were to fence the hills off and treat them differently, or sow rye on the hills and another crop in the flat. The options were generally expensive and time consuming.

The Sand rises are generally lower in nutrient, lighter in soil texture, but have no soil constraints. They are generally responsive to nutrient inputs. The Mid-slopes are higher in nutrient than the rises and again have low levels of soil constraints. The Flats are heavier textured with often high to very high a nutrient levels, however they often have constraints limiting root growth or prevent roots accessing the nutrients, such as boron, high pH, salts, sodicity, or physical layers such as class 2 calcrete

Variable rate combined with defined and well understood paddock zones can, as this trial shows, reap significant benefits in grain and gross margin. Peter Treloar, from his precision agriculture work in the Mallee made the following conclusions regarding farming to paddock zones in this way:

- Is not about trying to even up the yields across the paddock,
- It's about recognising and understanding the variations in yield potential.
- And applying the appropriate inputs to best allow that potential to be reached.
- It's not always about applying more fertiliser, but rather redistributing inputs into the areas of greatest potential return.

Table 4 below shows the large gross margins between paddock zones e.g. Control Rise ($323.95 return per ha) compared with Control Flat ($187.70 return per ha) a difference of $137.25. In this paddock the flats are quite unresponsive to P and we see that if we applied no fertiliser to the Flat we improved the GM to $221.67 return per ha. This is an advantage of $33.97 per ha.

This trial also shows that the flats are consistently lower yielding than the rises and mid-slopes despite the amount of growing season rainfall. In the drought year of 2009 (162mm growing season rainfall) the flats yielded on 68% of the rises and mid-slopes.

In Table 6 I have constructed a scenario which shows variable rate fertiliser against a flat rate fertiliser application extended over the whole paddock. In order to construct this table a variable rate prescription is devised and the yield results of the 2010 trial are used. If the variable rate prescription results are applied over the whole West Chamberlain paddock then variable rate would grow 19.394 t more grain than Flat Rate, using 1.864 t more fertiliser. Simple Gross Margin per ha of variable rate over flat rate is $29.72.

This scenario in Table 6 demonstrates the result of redistributing the inputs between the various paddock zones – targeting those areas responsive to increased fertiliser and reducing inputs in the unresponsive areas – usually the zones with lower unavailable water capacity.

In 2010 there were strong treatment effects – the best being Urea applied post sowing and the late sowing. Conventional wisdom and practice would suspect that late sowing is not a real option every year. Most growers would understand the yield penalties for sowing much later than the optimum seeding time in the Northern Mallee are considerable. For the past four years (2006 -2009) because of the droughts and low yields the best gross margins have been achieved with zero fertiliser application.

Late sowing and zero fertiliser are not broad recommendations that I would make. This trial clearly shows the advantages of making strategic nutrient inputs based on a good understanding of the paddock.

Post Urea application, despite the risk of volatilisation, from this and the 2009 trial shows very promising results in wet and dry seasons.

Take Home Message:

Variable rate fertiliser application has a real and profitable place in the Mallee when combined with good paddock science.

The precision technology gives the ability to examine the yield data for many effects including other possible influencing factors such as elevation, slope aspect or orientation to the sun, and probably many others.

Table 4 Yield, water use efficiency, grain quality and simple gross margins for each treatment. Grain price is as at 2 December 2011, Cash, Port Adelaide. Grain from all treatments was classified as ASW1. Statistical analysis for grain quality is also shown.

				Fert rate		Trt	Area	WUE	Grain Quality			Pay	farm gate	$/ha	$/ha	$/ha		$ Diff
Variety	Trt #	Treat 1	Treat 2	Treat 1	Treat 2	Yield	(ha)	kg/mm	Protein	Scrn	TW	Grade	$/tonne	Return	Fert cost	GM	Rank	to best
Correll	1	DAP	0 N	60	0	1.708	2.125	3.4	8.9	1.8	76.8	ASW1	190.00	324.43	51.00	273.43	2	-8.95
Correll	2	DAP+N	0 N	70	0	1.763	2.125	3.5	9.4	2.3	75.7	ASW1	190.00	334.88	52.50	282.38	1	0.00
Correll	3	DAP+N	SOA	70	80	1.713	2.125	3.4	10.3	2.4	75.9	ASW1	190.00	325.47	100.50	224.97	3	-57.41
Correll	4	DAP+N	Urea	70	80	1.609	2.125	3.2	9.3	2.2	75.5	ASW1	190.00	305.62	96.50	209.12	4	-73.26
Mean						1.698			9.5	2.2	76.0							
Lsd (P<0.05)						NS												
CV %						3.9												
P (0.05)						0.306												

Trt #	Treatment	Yield	Protein	Scrn	TW	WUE	GM $/ha
1	DAP + 0 N	2.125	8.9	1.8	76.8	3.4	273.43
2	DAP+N + 0 N	2.125	9.4	2.3	75.7	3.5	282.38
3	DAP+N + SOA	2.125	10.3	2.4	75.9	3.4	224.97
4	DAP+N + Urea	2.125	9.3	2.2	75.5	3.2	209.12

Grain Prices, best cash price on 2 Dec 2012

Grade	Pro	TW	Scrn	$/tonne Price
H1	13	74	5	287.00
H2	11.5	74	5	244.00
APW1	10.5	74	5	215.00
ASW1		74	10	190.00
AGP1		68	10	185.00
Feed1		64	15	180.00

GSR	235		mm
Jan-Mar (1/3)	1120	373.3	mm
WUE (kg/mm)	3.3		
Evap rate	100		mm

Product	$/t	rate	$/kg	$/ha
DAP	850.00	60	0.85	51.00
DAP+N	750.00	70		52.50
Urea	550.00	80		44.00
SOA	600.00	80		48.00

					Fert rate		Trt	Area	WUE				Pay	farm gate	$/ha	$/ha	$/ha	$ Diff
Variety	Trt#	Treat 1	Treat 2	EW	Treat 1	Treat 2	Yield	(ha)	kg/mm	Protein	Scrn	TW	Grade	$/tonne	Return	Fert cost	GM	to best
Correll	1	DAP	0 N	E	45	0	1.708	1.06	3.4	9.55	2.1	77.4	ASW1	190.00	324.43	51.00	273.43	-8.95
Correll	1	DAP	0 N	W	45	0	1.708	1.06	3.4	8.20	1.6	76.2	ASW1	190.00	324.43	51.00	273.43	-8.95
Correll	2	DAP+N	0 N	E	45	0	1.763	1.06	3.5	10.15	2.8	74.7	ASW1	190.00	334.88	52.50	282.38	0.00
Correll	2	DAP+N	0 N	W	45	0	1.763	1.06	3.5	8.70	1.9	76.7	ASW1	190.00	334.88	52.50	282.38	0.00
Correll	3	DAP+N	SOA	E	45	50	1.713	1.06	3.4	10.45	2.5	76.9	ASW1	190.00	325.47	100.50	224.97	-57.41
Correll	3	DAP+N	SOA	W	45	45	1.713	1.06	3.4	10.10	2.3	74.9	ASW1	190.00	325.47	100.50	224.97	-57.41
Correll	4	DAP+N	Urea	E	45	35	1.609	1.06	3.2	10.00	2.6	75.0	ASW1	190.00	305.62	96.50	209.12	-73.26
Correll	4	DAP+N	Urea	W	45	45	1.609	1.06	3.2	8.60	1.8	76.5	ASW1	190.00	305.62	96.50	209.12	-73.26
Mean							1.698			9.47	2.2	76.0				Av.	247.47	
Lsd (P<0.05)										0.605	NS	NS				Max	282.38	
CV %										6.2	16.4	2.0						
P (0.05)										0.019	0.1028	0.481						

Table 6 Comparison of financial benefit of Variable rate versus Flat rate if the 2010 results were applied over the whole paddock.

Paddock West Chamberlain

Zones created with Your Soils Potential on 2008 EM 38 map

		Yield		Fertiliser Rate (kg/ha)			Total Fertiliser used (t)			Total Grain Grown (t)		Gross Income $		Gross Margins $/ha	
				Flat	Variable		Flat	Variable							
Zone	**Total Area**	**Flat**	**Variable**	**DAP**	**DAP**	**Urea**	**DAP**	**DAP**	**Urea**	**Flat**	**Variable**	**Flat**	**Variable**	**Flat**	**Variable**
Sandhill	16.0	1.614	2.121	45	45	90	0.7	0.7	1.4	25.8	33.9	5422.23	7124.94	338.91	445.33
Mid slope	97.8	1.600	1.713	45	60	0	4.4	5.9	0	156.5	167.5	32856.83	35176.47	335.97	359.69
Flat	23.2	1.046	1.056	45	0	0	1.0	0.0	0	24.2	24.5	5088.56	5138.00	219.63	221.76
	137.0						6.2	6.6	1.4	**206.5**	**225.9**	43367.62	47439.42		

Comparison Variable Rate - Flat Rate		
Difference in Grain	19.394	tonne
Difference in Fertiliser	1.864	tonne

Income over 137 ha	$4,071.80
GM $/ha	$29.72

Simple Gross Margin per ha = $29.72

If the results are applied over the whole paddock VR would grow 19.394 t more grain than Flat Rate using 1.864 t more fertiliser

Who was involved?

Mark and Sue Stoeckel, Growers, Bunyip Reach
Peter Treloar, Precision Ag services and Vision Ag.
Richard Saunders, Rural Solutions SA, Trials Coordinator
Mike Mooney, Manager, Mallee Sustainable Farming Inc.

Grower/Regional feedback:

Mark is still concerned that despite the excellent growing season rainfall in season 2010 his water use efficiencies are still relatively low, and this paddock compared to other paddocks responded poorly in yield.

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For more information

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