Precision Ag Trials

VARIABLE RATE TECHNOLOGY EVALUATION

Minnipa Agricultural Centre

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 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 demonstration at **Minnipa Agriculture Centre** from the 2011 season.

Grower/Regional feedback following the demonstrations:

Mark Klante commented that "it was very easy to use variable rate at seeding and allowed an opportunity to test crop yields or response to different fertiliser rates. Using VRT trials we have the potential to save money in poorer zones and in dryer years. In the better areas it allows a confident increase in nitrogen fertiliser application and reduces the need to go back with a second application."
Peter Treloar "We have not seen any benefit of increasing fertiliser rates due to the high fertility on the Minnipa farm. The greatest gross margin benefit has been using a low fertiliser rate on the poor or risky zones."
Linden Masters An article in Eyre Peninsula Farming Systems Summary 2011 p102 "Can adjusting zones within N1 paddock at Minnipa improve outcomes" adds further value to this discussion.

Why do the trial?

Aims:

Using yield maps and EM38 mapping in determining the drivers of crop production – fertiliser strategy or soil characteristics?

- To compare the effects on using variable fertiliser rates at seeding in four production zones based on yield maps, EM maps and combining both.
- To determine if EM38 mapping adds value to yield mapping in the preparation of a VRT fertiliser strategy?

Background:

The Minnipa Agriculture Centre (MAC) was established in 1915. It has an average annual rainfall of 325 mm and a growing season rainfall of 241 mm. It is ideally situated to provide valid information to the dryland farming community through incorporating science, technology and practical farm experience.

Trials conducted at Minnipa are an important part of exposing VRT to the wider community of upper Eyre Peninsula. Initially a four year continuous cereal white peg trial examining water use and phosphorus response has shown little yield response to using 0 kg/ha, 40 kg/ha and 80 kg/ha of 18:20 (DAP) irrespective of paddock zone. The zones were based on EM38 mapping, yield and elevation maps. Subsequently the entire MAC farm has been EM38 mapped to allow soil zones to be correlated with yield maps. Minnipa Ag Centre has a relatively high fertility level but it was hoped to use demonstrations to observe whether yield variations were phosphorus, nitrogen or plant available water related and to extend these commercial results so that other farm managers will be able to gain confidence in using this technology.

How was it done?

The MAC paddocks were EM38 mapped in 2010 by Peter Treloar, Precision Ag Services (Figure 1) and the yield data was collected and collated from 2009 to 2010 from a Case 3266 header purchased in 2009.

Minnipa Ag Centre's farming operation consists of direct drilling using a 9 metre Howard PSS bar, knife points and press wheels; a triple box Morris air seeding cart using a Top Con X20 controller for VRT; the Case 2366 header uses a Case Pro 600 yield monitor with a 9 metre front; GPS Ag guidance system of two centimetre accuracy is moved between the two machines. Having the same width machines makes trial work very easy.

Variable rate strips were selected covering different EM zones. In the cereal paddocks following on from pasture high and nil rates of 18:20 were used. In the continuous cropped cereal paddocks different rates of urea were applied.

To compare the use of yield maps and EM38 mapping to determine the drivers of crop production, a number of demonstrations were carried out on paddocks at Minnipa Agricultural Centre in 2011.

The comparisons included:

- The use of VRT using EM38 mapping and yield maps
- To compare different rates of 18:20 fertiliser in paddock South 5 (cereal following pasture paddock)
- The use of nitrogen rates at sowing in paddock North 7/8 (4th year cereal paddock)

Demonstration 1 (Paddock South 5)
Replacement P vs Flat rate

Using a yield map from the 2010 harvest, and based on a P replacement strategy (calculated assuming export of 3 kg/t grain delivered) resulted in 18:20 (DAP) applied at rates of 50, 60, 70 and 80 kg/ha in four zones and compared with a flat rate of 58 kg/ha.

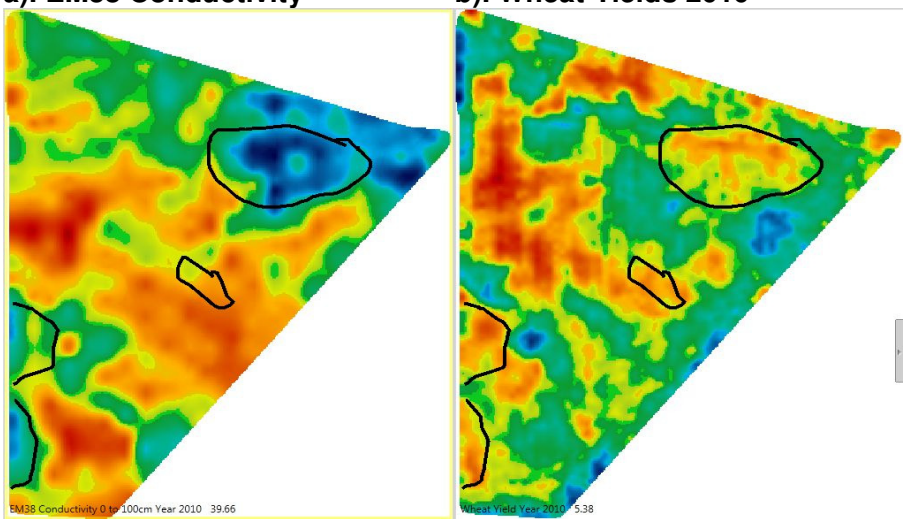
Demonstration 2 (Paddock South 5)
Using EM38 values to determine VR P strategy vs Flat rate

From EM38 values, five zones were created with fertiliser application applied at 30, 45, 60 and 75 kg/ha of 18:20, comparing a flat rate of 18:20 applied at 58 kg/ha.

Demonstration 3 (Paddock North 7/8)
Comparing nitrogen rates at sowing
Airseeder widths using 0, 20, 30 and 40 kg/ha of urea were sown across the paddock at seeding, allowing five different EM 38 zones yields in response to N rates to be compared.

Figure 1 Paddock South 5. The 2010 yield map was used to indicate a replacement P strategy for the 2011 wheat crop.

a). EM38 Conductivity **b). Wheat Yields 2010**



The maps in Figure 1 allow a visual comparison of soil values and yield. EM soil values remain consistent, yields vary depending on season.

Figure 2 Comparing 2011 yield map with existing EM 38 maps

a). 2011 Wheat Yields **b) Trial strips covering EM values**

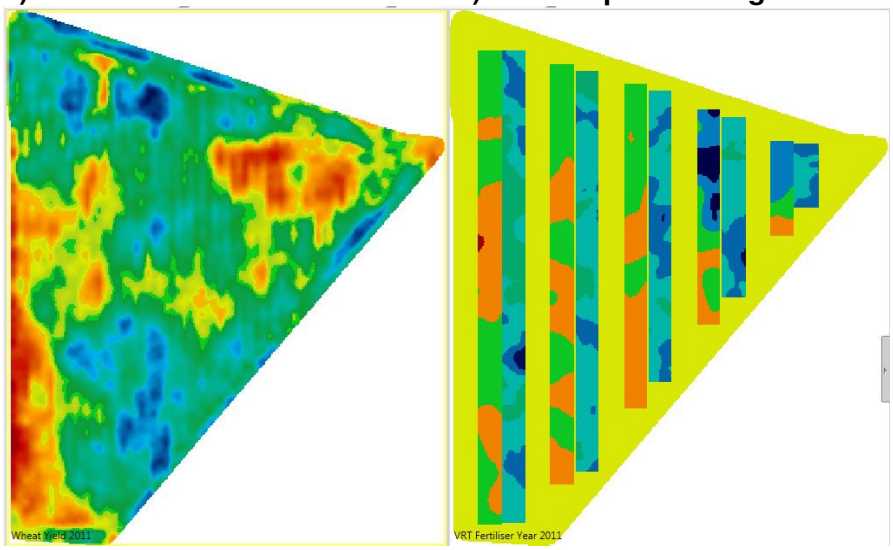
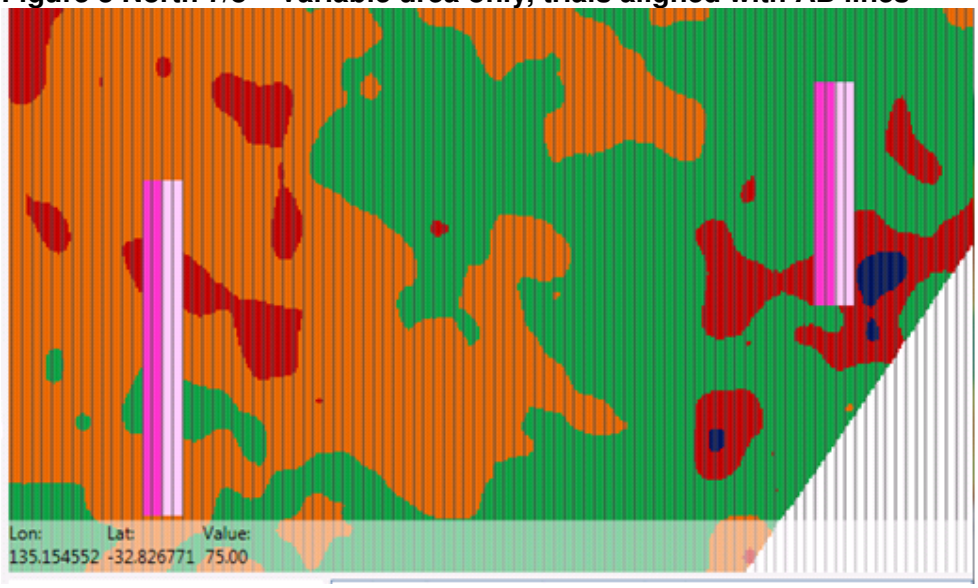
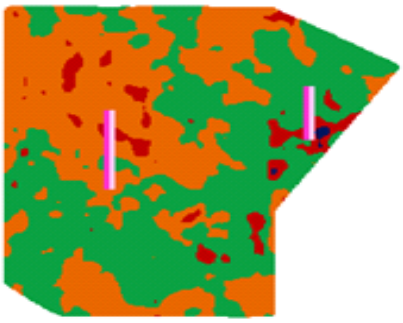


Figure 2 maps were used to determine placement of VR demonstrations.

Figure 3 North 7/8 – Variable urea only, trials aligned with AB lines



	Zone	VRT Fertiliser	Area (ha)	
	1	0 (0.00)	0.9	
	2	0 (0.00)	0.2	
	3	0 (0.00)	5.6	
	4	0 (0.00)	0.9	
	5	0 (0.00)	54.6	
	6	0 (0.00)	47.7	



What happened?

2011 wheat yields were above average due to sowing in May with good stored water from summer rains. The growing season rainfall of 252 mm tracked at decile 5 however no rain was received for six weeks in August to mid September.

Table 1 Demonstration 1 (Paddock South 5) Replacement P vs Flat rate

Yield Zone	VR 18:20	VR Yield	Flat rate Yield	Flat rate 18:20	Zone Area
	kg/ha	t/ha	t/ha	kg/ha	ha
1	50	2.21	2.04	58	5.4
2	60	2.35	2.15	58	16
3	70	2.47	2.41	58	8.4
4	80	2.63	2.53	58	0.75

There was no variation in yield as a result of increasing P rates compared to the flat P rate of 58 kg/ha (Table 1). Yield responses followed zones that were based on previous yield maps.

Table 2 Demonstration 2 (Paddock South 5) Using EM38 values to determine VR P strategy vs flat rate

EM Zone	VR 18:20	VR Yield	Flat rate Yield	Flat rate 18:20	Zone Area
	kg/ha	t/ha	t/ha	kg/ha	ha
1	75	2.28	2.28	58	12
2	60	2.33	2.22	58	14
3	45	2.08	1.94	58	4
4	30	1.81	1.86	58	0.5

In South 5 the high EM38 values showed decreased yields in these areas affecting plant available water and sub soil constraints (Table 2). Results show yields followed soil type. The yield followed the EM zones rather than the fertiliser rates. There was no yield loss by decreasing rates where EM suggested high subsoil constraints (Zones 3 and 4).

Table 3 Demonstration 3 (Paddock North 7/8) Comparing nitrogen rates at sowing to measure urea rate yield response

Urea (kg/ha)	Area (ha)	Min yield (t/ha)	Mean yield (t/ha)	Max yield (t/ha)	Std Dev	CV
0	1.42	0.43	1.7	2.37	0.34	0.2
20	2.54	0.41	1.69	2.36	0.39	0.23
30	45.22	0.42	1.65	2.48	0.28	0.17
40	34.87	0.41	1.55	2.5	0.43	0.28

In North 7/8 high fertility at Minnipa and good summer rains allowed good mineralisation and little yield increase was obtained from higher nitrogen rates (Table 3). The design of this trial allowed flexibility in observing yield data from the different EM38 zones and using different rates of nitrogen in the form of urea. There was a negative trend in lower average yield following a higher urea application on less constrained soil.

Table 4 Demonstration 3 (Paddock North 7/8) EM38 zone average yields

EM Values	Area (ha)	Min yield (t/ha)	Mean yield (t/ha)	Max yield (t/ha)	Std Dev	CV
26.9	2.3	0.41	1.5	2.5	0.57	0.38
47	46.53	0.41	1.58	2.5	0.42	0.27
68.8	52.98	0.42	1.66	2.5	0.3	0.18
93	3.05	0.59	1.7	2.45	0.26	0.15
112.5	0.19	1.26	1.83	2.32	0.22	0.12

The results from Table 4 show increased yield is strongly correlated with increasing EM zone values.

What does this mean?

On upper Eyre Peninsula few people use EM38 mapping to support the use of VRT. Currently yield maps and paddock knowledge are the most commonly used methods for determining production zones within paddocks.

The demonstrations show that increasing fertiliser rates did not have an effect on yields but yields did follow EM38 mapped soil zones.

In Demonstration 1 (Table 1 & 2) there was no significant yield difference in response to VR applications of phosphorus over the flat rate of 58 kg/ha of 18:20.

In Demonstration 2, VR yield followed EM zones in both VR and Flat rates. We didn't see any benefit from increasing fertiliser rates possibly due to the high fertility at Minnipa (Paterson, C., R. Latta, et al. (2011). "Responsive farming using variable rate sowing at Minnipa." Eyre Peninsula Farming Systems Summary 2010: 85-89.), but we didn't see any loss of yield by decreasing rates either where the EM suggested high subsoil constraints. This suggests there is room for farmers to reduce risk by reducing fertiliser on heavier constrained soil, without losing any yield potential.

In Demonstration 3, a large difference between minimum and maximum yield values occurred in the four urea rates treatments indicating another driver apart from nitrogen. This same trend followed in the EM38 zones suggesting a need for more work to be done in this area. This demonstration showed an opposite trend with EM than that in South 5, with higher yield coming from the highest EM zones, even though end of season moisture tests showed a clear relationship between EM and soil water, with the most soil water left behind in the highest EM zones. There was no effect of rates of nitrogen fertiliser on yield, suggesting the most economic option was for no urea to be applied in Paddock North 7/8.

Who was involved?

Minnipa Agricultural Centre

MAC Farm Manager	Mark Klante
Farm Hand	Brett McEvoy
Trials coordinator	Peter Treloar
FSG contact	Linden Masters

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