Yorke Peninsula Precision Ag Trials

Variable Rate Phosphorus & Nitrogen Trials on YP

Arthurton(Phosphorus) and Ardrossan(Nitrogen), 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 trials conducted in conjunction with the Yorke Peninsula Alkaline Soils Group at Ardrossan and Arthurton.

Aims:

- To evaluate the potential of phosphorus replacement as a method of applying Variable Rate fertiliser.
- Compare EM38 and NDVI as guides for Nitrogen Application.
- Illustrate how simple farmer trials can be used to assess the benefits of variable management.

Background:

The two major inputs farmers most readily think of in regards to Variable Rate are Nitrogen and Phosphorus. To evaluate the potential of using Variable Rate; SPAA and YPASG established two demonstration sites, one at Arthurton focused on phosphorus using P-Replacement methodology, the other at Ardrossan comparing different rates of Post N.

The paddock at Arthurton had only partial yield data from the last two seasons, to help fill in the gaps historic NDVI was used.

To further understand variability found in each paddock EM38 Soil Surveys were undertaken and NDVI was collected during the year. At the Ardrossan trial this was collected twice – once via satellite and again by tractor mounted crop sensors supplied by TOPCON.

About the trial: Phosphorus at Arthurton

The 2 years previous yield data were incomplete so historic NDVI was used to help fill in the gaps and the following zone map was created.

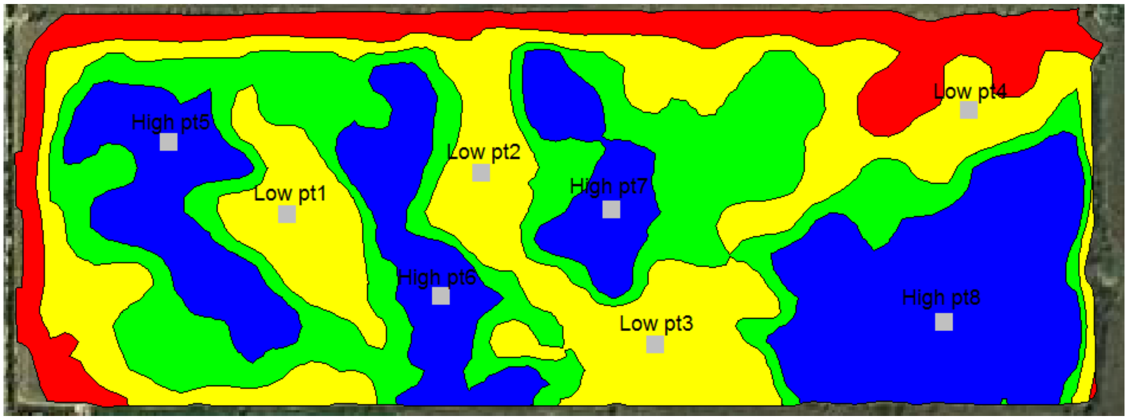


Figure 1. Historic Production Zones (Red=low, Blue=high)

The farmer then placed a flat rate trial strip across the top of the paddock and sowed the rest according to historic production zones.

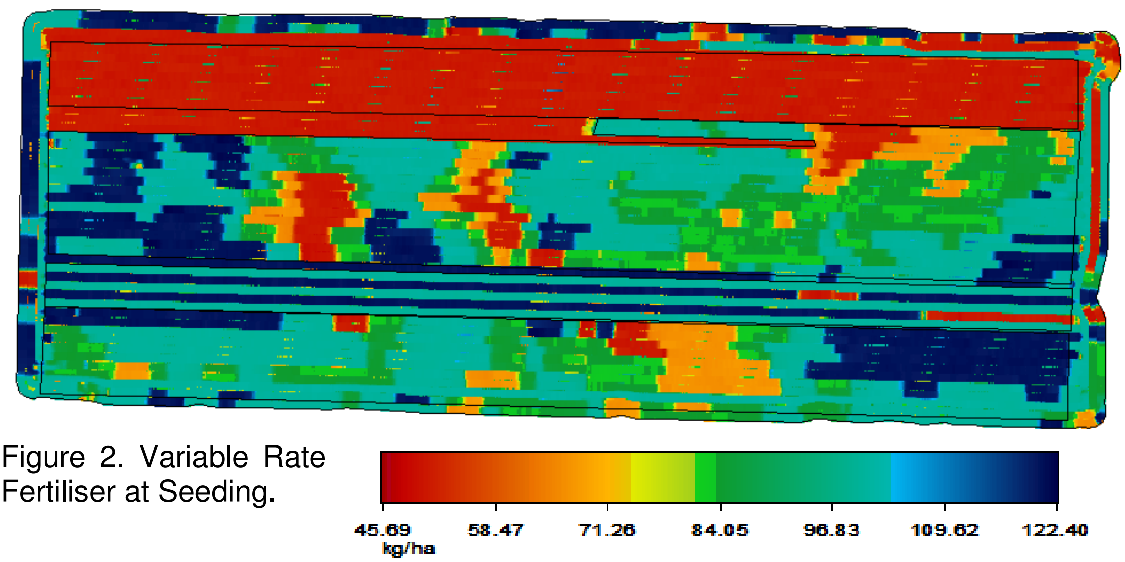


Figure 2. Variable Rate Fertiliser at Seeding.

The whole paddock also received 80l/ha of UAN.

Assessments: Tissue Tests and Grain Yield

Table 1. Soil test results

Zone	Point	Colwell P mg/kg	PBI	Critical Colwell P	Predicted response with Colwell P	CDGT mg/L	GS30 257 mg/L	Grain 57 mg/L	Predicted response with DGT	Conductivity dS/m	pH Level (CaCl2) pH	pH Level (H2O) pH	ESP %
Low	1	120	58	23	N	180	83	100	N	0.437	5.1	5.7	8.7
Low	2	113	52	22	N	326	94	100	N	0.124	5.7	6.7	6.6
Low	3	87	113	29	N	128	75	99	N	0.24	7.6	8.2	3.5
Low	4	80	169	35	N	147	78	100	N	0.295	7.9	8.5	3.6
High	5	45	85	26		63	60	92	N	0.216	7.8	8.4	1.1
High	6	63	153	33	N	87	66	96	N	0.277	7.7	8.3	1.8
High	7	57	121	30	N	57	58	90	N	0.235	7.8	8.4	1.8
High	8	62	164	34	N	49	55	87	M	0.211	7.7	8.2	1.9

Table 2. Plant Tissue test results

		Leaf Nutrient Analysis										
Location	**Treatment (kg DAP/ha)**	**Fe mg/kg**	**Mn mg/kg**	**B mg/kg**	**Cu mg/kg**	**Zn mg/kg**	**Ca %**	**Mg %**	**Na %**	**K %**	**P %**	**S %**
High NDVI in historical Landsat	**120**	73	30	6	8.5	23	0.45	0.16	0.04	2.57	0.32	0.34
High NDVI in historical Landsat	**50**	71	31	5	8.0	22	0.45	0.15	0.04	2.35	0.32	0.34
Low NDVI in historical Landsat	**120**	90	56	11	9.2	15	0.28	0.15	0.05	2.84	0.43	0.35
Low NDVI in historical Landsat	**50**	80	55	9	7.8	20	0.32	0.14	0.05	2.93	0.42	0.38
High NDVI in in-season Apogee image	**50**	88	75	6.3	5.4	22	0.38	0.13	0.03	3.08	0.46	0.45
Low NDVI in in-season Apogee image	**Average**	75	53	5	11	25	0.70	0.20	0.06	1.41	0.34	0.38
Critical nutrient levels at GS33												
Deficiency		25	20		3	16	0.20	0.12		2.50	0.28	0.30
Toxicity				40					2.00			

Results:

Tissue Tests results are presented in the appendix table 2.

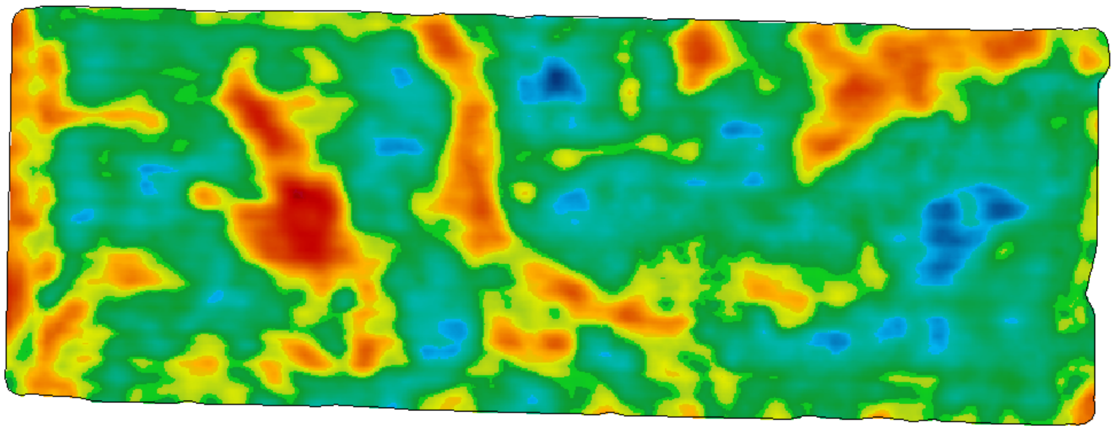
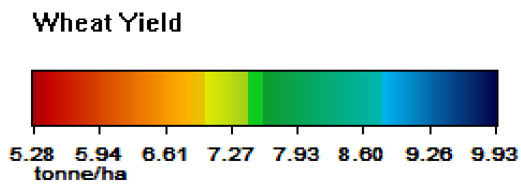


Figure 3. Yield Map from P Trial.



Mean paddock yield = 7.65 t/ha

Applied Rate	Grain Yield t/ha VR	Grain Yield t/ha 50kg/ha
120 kg	7.96	8.05
100 kg	8.03	7.85
82 kg	7.97	7.21
65 kg	7.28	7.04
50 kg	6.37	6.25

Table 3. Yield results comparing Variable Rate fertiliser at seeding against flat 50kg/ha.

From the soil tests in Table 1 we can see there were very adequate reserves of soil phosphorus across the paddock. With significant differences between the historic high and low production areas. The areas of high historic production had lower levels of P, despite receiving the same levels of fertiliser P over the life of the paddock. This is due to more been removed via crop production as seen in the historic NDVI.

In Table 2 we can see the plant has adequate phosphorus and there is no difference between fertiliser treatments. But there is significant difference between historic production zones, further backing up the results of the soil tests.

In Table 3 we can see that there is no significant difference between the variable rate applied P and the flat rate of 50 kg/ha. Despite the differences seen at rates of 82 and 65kg/ha these areas are not of sufficient size to base a conclusion on. Especially since all the other treatments are virtually the same.

The paddock has also been EM38 soil surveyed and had data collected by the AZNIR satellite.

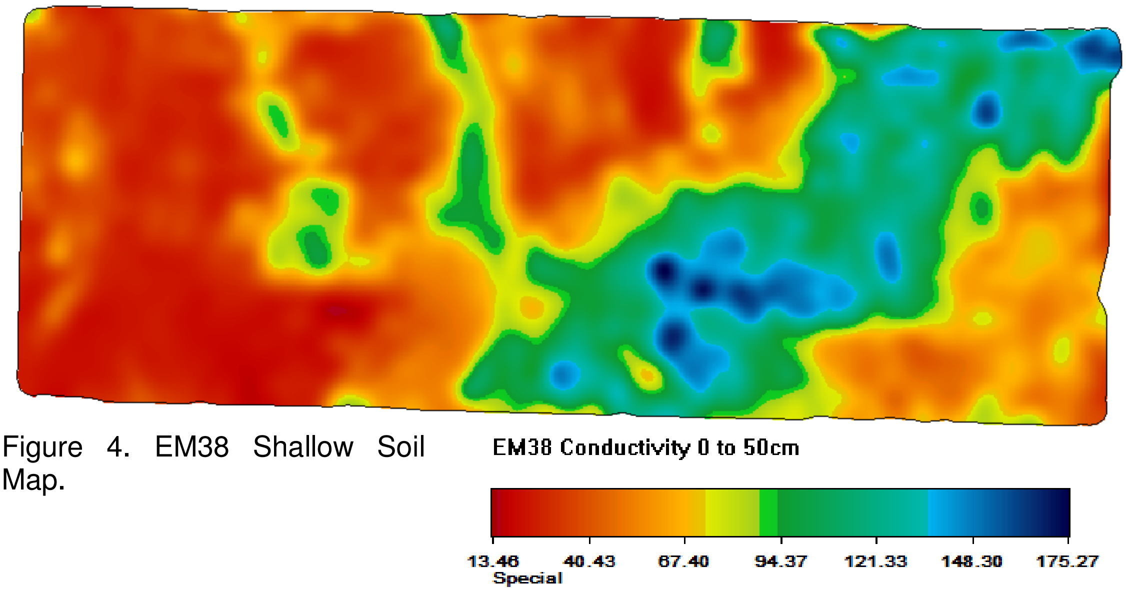


Figure 4. EM38 Shallow Soil Map.

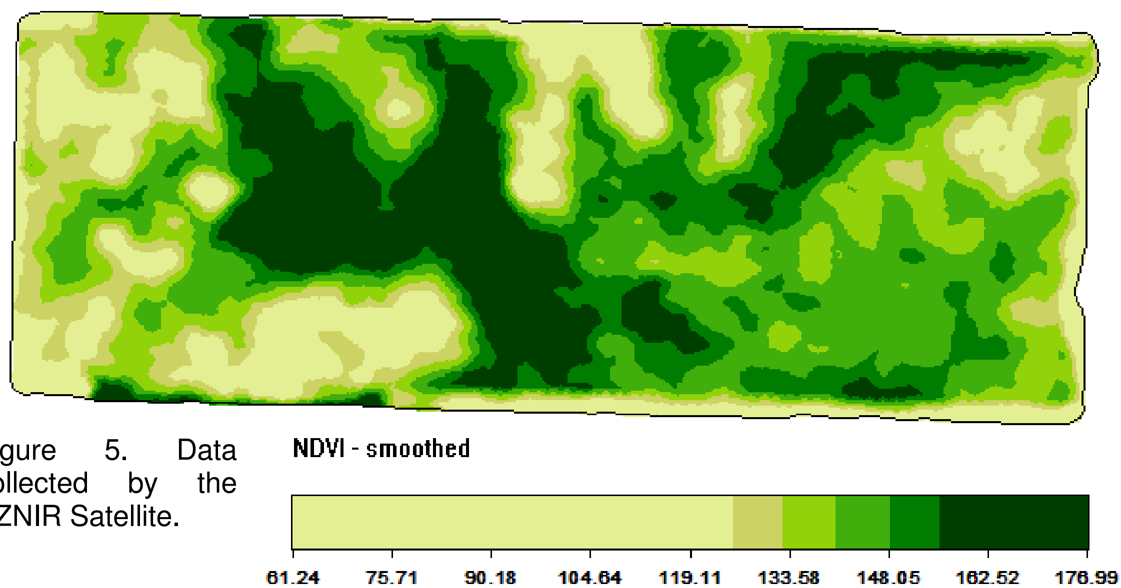
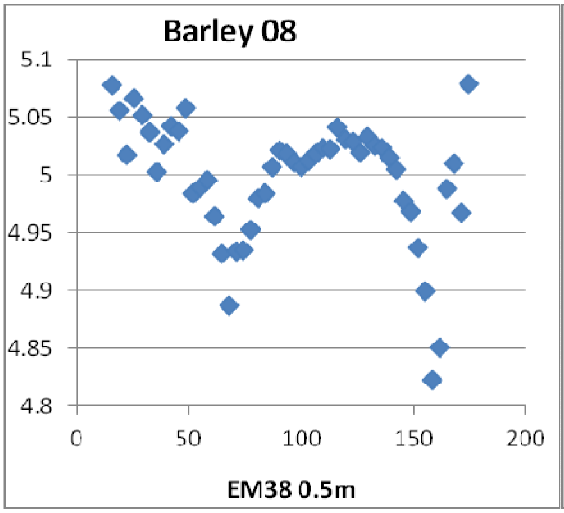
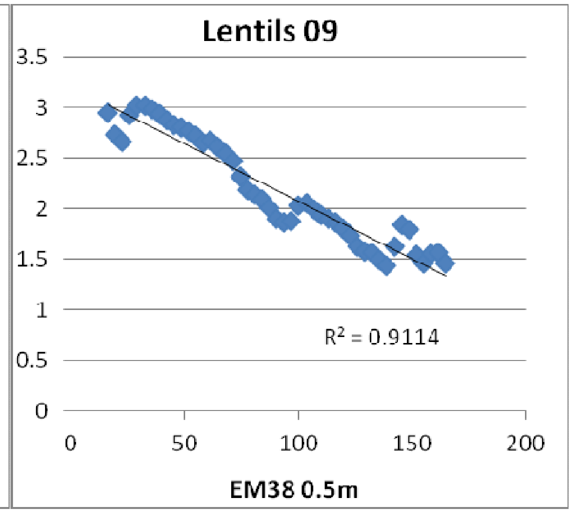
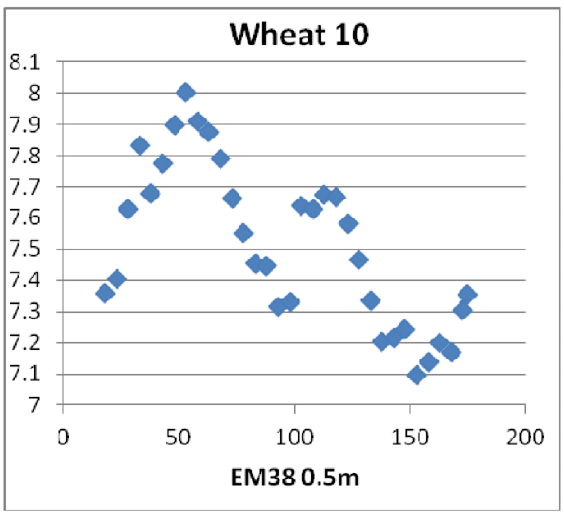


Figure 5. Data collected by the AZNIR Satellite.







Graph 1. Illustration of yield against EM38 (shallow) for Barley (2008), Lentils (2009) and Wheat (2010)

As the graphs of yield against EM show there is no relationship with either cereal crop in 2008 or 2010, but with lentils there is a very strong inverse relationship.

This is more likely due to crop type then seasonal conditions as this relationship has been recorded in other lentil crops.

Discussion:

The potential to manage Phosphorus fertiliser inputs by matching inputs to production is a viable option for farmers. But it is important to understand background soil fertility when employing a P Replacement strategy. As seen in this trial the low flat rate of 50kg/ha would have returned the highest gross margin as it had no impact on yield compared to the Variable Rate P. But as a long term strategy this would lead to mining of P reserves, especially in such high yielding crops.

The in season NDVI was taken earlier then the data used for the historic production zones and the farmer has made comment the high value zones are more related to ryegrass populations then crop production. This opens the potential for variable rate herbicide applications either in season or preseason the following year.

About the trial: Nitrogen at Ardrossan

A simple nitrogen trial was designed to compare different rates of nitrogen across varying soil types.

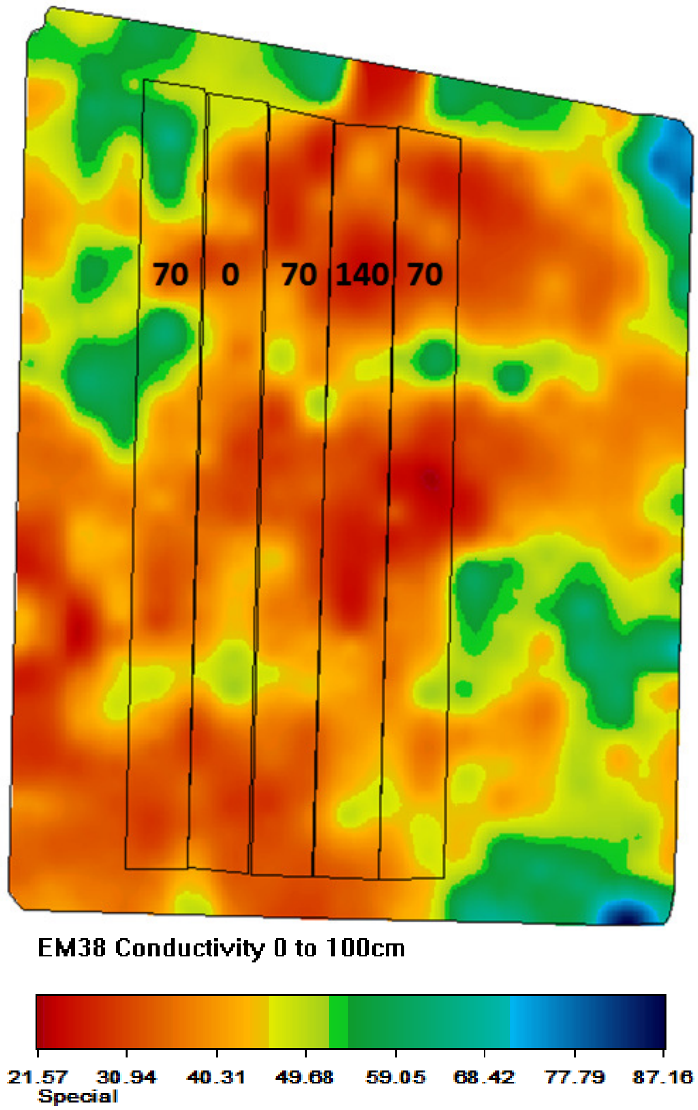


Figure 6. EM38 (Deep) Soil Survey with trial design overlayed.

The paddock was sown with a flat rate of fertiliser and then treated with a flat rate of 70kg/ha of Urea. The farmer set up a trial where one strip received 0kg/ha of Urea and another received double.

The paddock was also surveyed with a Crop Spec sensor supplied by Topcon, on 30m swaths, and by the AZNIR Satellite with 10m pixels.

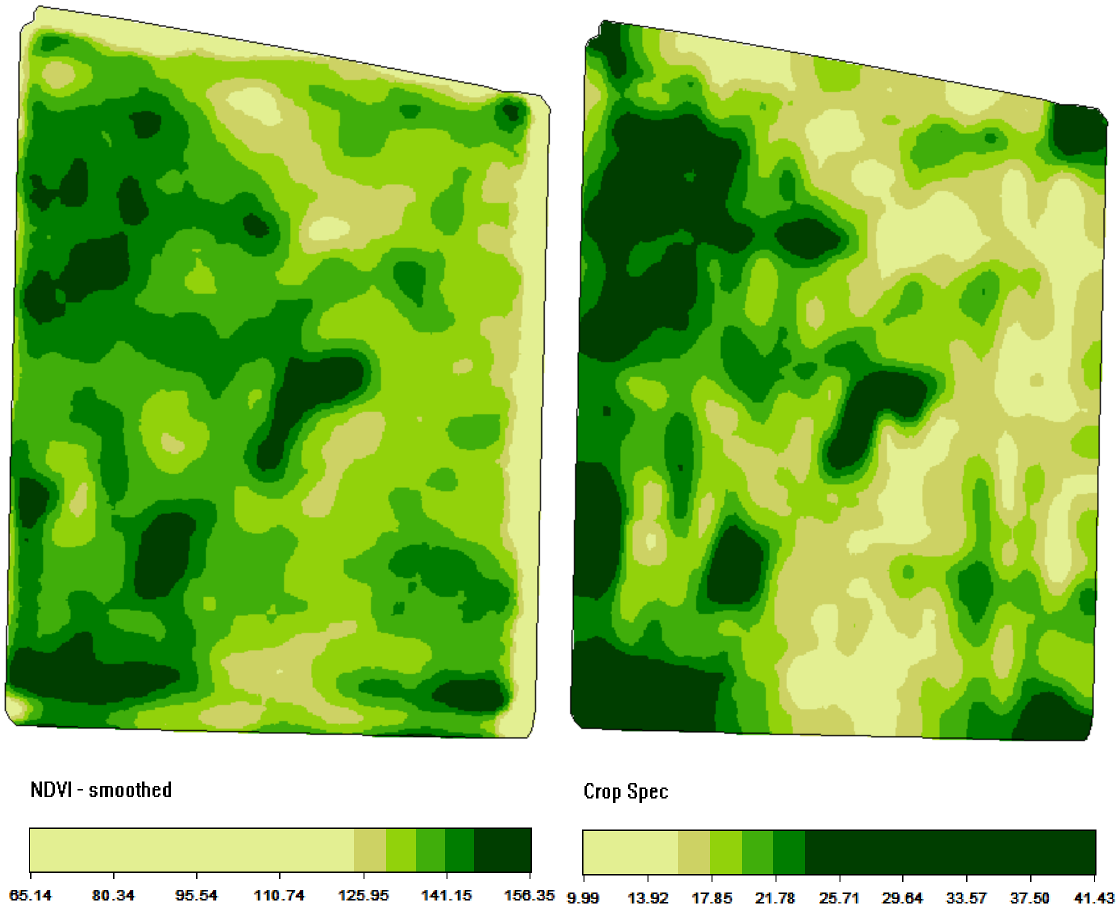
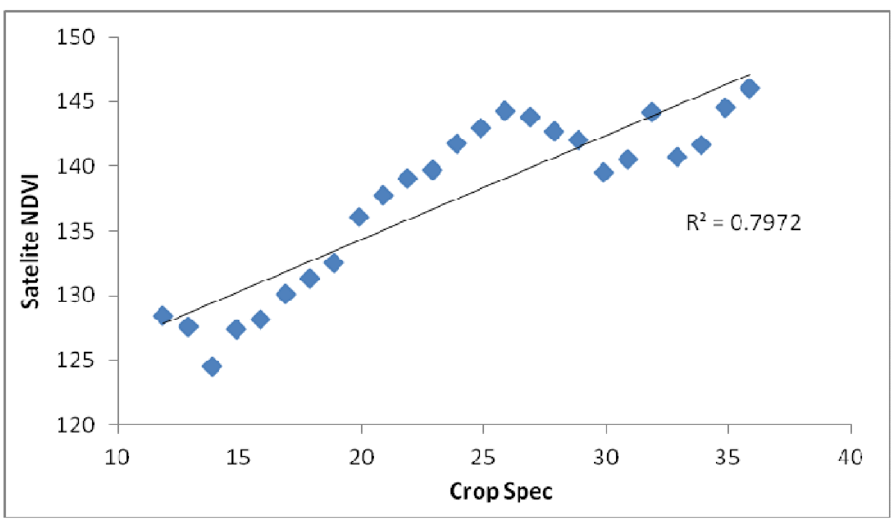


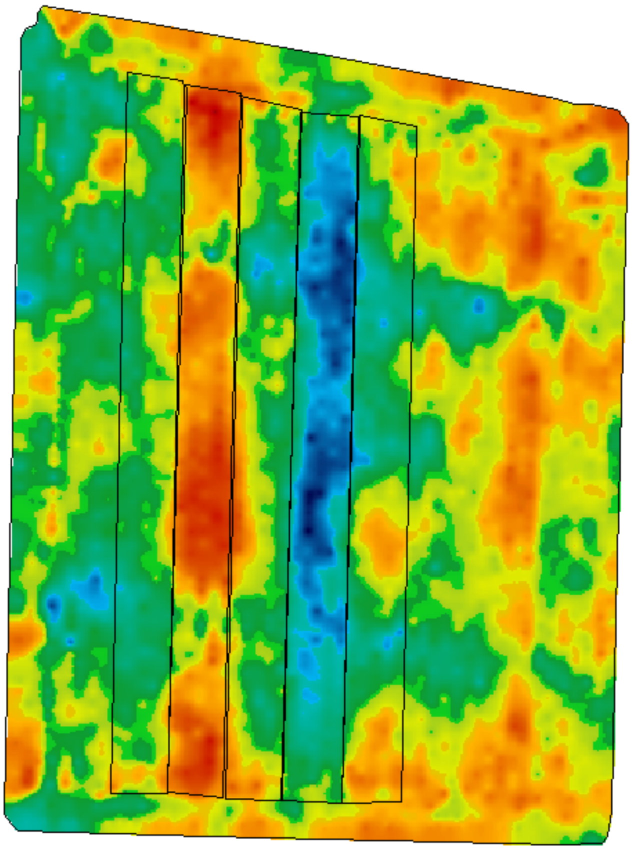
Figure 7. AZNIR Satellite image (left) and Crop Spec image (right) collected within a couple of days of each other.



Graph 2. Comparison of two methods of crop imagery collection.

Figure 7 and Graph 2 show that the two methods of NDVI collection return a very similar result. While it is not perfectly the same this is probably due to collection methods where one is collected in swaths and the other is a higher resolution option.

Results:



Urea Rate	Yield
70	4.96
140	5.71
70	4.88
0	4.25
70	4.97
Pd. Ave	4.83

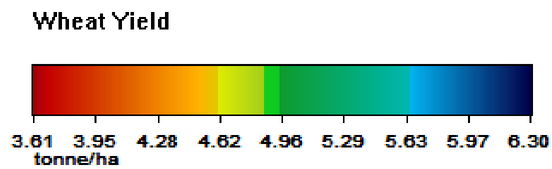
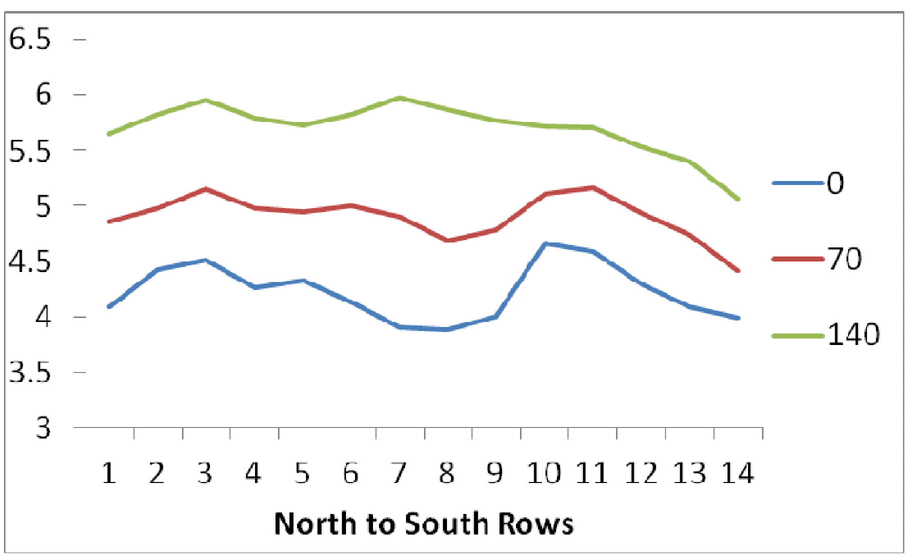


Figure 8. Yield Map and Results table for Nitrogen Application.

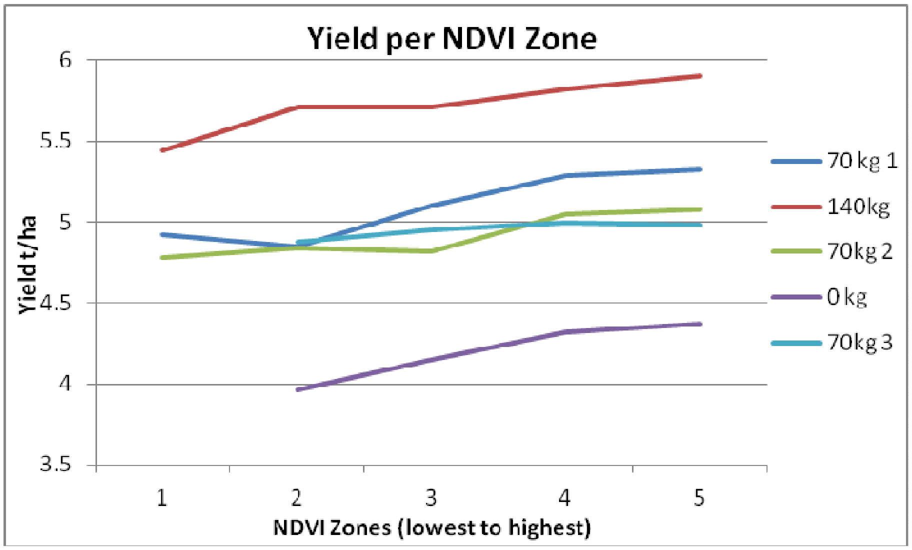


Graph 3. Profile comparison of treatments running north to south.

The effect of Nitrogen can easily be seen in the yield map with the 140kg/ha of urea and 0kg/ha clearly standing out compared to the standard practice of 70kg/ha.

Discussion:

This trial was set up to look at interactions between Nitrogen application and paddock variability. While there is a small interaction between yield and NDVI there wasn't an interaction with rate of Nitrogen. This can be seen in graph 4 where there is a slight increase in yield as NDVI increases, each treatment of nitrogen has the same pattern.



Graph 4. Interaction between Yield and NDVI.

There was no interaction between EM38 and Yield or nitrogen application. There was a similar effect on lentils as seen in the trial at Arthurton, where lentil yield declined as EM value increased.

The results of this trial may be more related to the season then any paddock variability, as the 2010 season again showed that timing is just as if not more important than amount of rainfall received. Regular rainfall and a cool finish meant crops were not moisture limited and roots did not need to seek much subsoil moisture to finish.

Who was involved?

Aaron Jak and Mark Graham, Growers, Arthurton.
Greg and Simon Wheare, Growers, Ardrossan.
Sam Trengove, Trengove Consulting.
Leighton Wilksch, Landmark Precision Ag Agronomist.
Peter Treloar, Precision Ag services and Vision Ag.
Topcon, supply of Crop Spec Sensor

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For more information

Nicole Dimos
SPAA Executive Officer
P: 0437 422 000
E: nicole@spaa.com.au

Peter Treloar
Precision Ag Services
P: 0427 427 238
E: pete.pas@internode.on.net

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