Precision Ag Trials

TRIAL TYPE: Phosphorus Response

Mannanarie SA, Upper North Farming Systems

Overview:

Precision Agriculture (PA) tools have been available to Australian grain growers for many years with the benefits well documented. It is estimated however that less than 1% of grain growers utilise PA beyond ‘guidance’ in any form. In fact guidance alone (driving in straight lines) is not PA.

The objective of this GRDC funded project, coordinated through SPAA is to increase the level of adoption of PA by broadacre farmers beyond ‘guidance’. The project specifically aims to increase the level of adoption of variable rate (VR) by growers involved with the project to 30% by 2013. This goal will be achieved by demonstrating how to use PA tools at a regional level and by increasing the skills of growers and industry in PA to a level where they can confidently 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 during farm walks. Workshops also mention outcomes of these trials to help farmers apply the messages to their own farming situations.

Aims:

- To compare the effects of different phosphorus rates and soil types on wheat production
- To extend information to local growers and identify where savings can be made

Background:

Phosphorus fertiliser is essential for plant growth and development, particularly in the first six weeks, as it forms the basis of amino acids which are the building blocks of proteins. Some soil types have the ability to ‘tie up’ phosphorus preventing uptake by plants. On these soils, additional phosphorus will not increase its availability, so applying phosphorus becomes a cost to a farmer without extra return. This trial was established to investigate the impact of varying phosphorus fertiliser rates on the growth of wheat across different soil types. The outcomes will hopefully lead to savings on-farm through identifying soil types that will and will not respond to additional phosphorus fertiliser.

About the trial:

The trial was located 8 km south of Mannanarie township. A wheat crop was sown at the site in late May 2010, but due to very cold conditions experienced at the trial site the crop was quite late in maturity.

Wheat was sown across a range of soil types and production zones (derived from yield maps) with different phosphorus rates applied in separate strips. The site was visited as part of a crop walk in August 2010. GPS coordinates of certain zones of high and low production potential were used to soil test and ground-truth the yield maps. At harvest wheat heads were selected from these zones and threshed out to estimate grain yield. At the end of the season the paddock was harvested using a conventional header with yield mapping capability.

Table 1: Treatments applied in MAP strips at the site in 2010

Treatment	MonoAmmonium Phosphate (MAP) rate (kg/ha)
1	0
2	40
3	80
4	120
5	160
6	Variable Rate P Replacement

Soil samples were taken and analysed a few weeks after seeding. Soil samples were taken from high and low producing areas of the paddock using GPS coordinates. These samples were tested for phosphorus and other chemistry (Table 2).

Results:

Assessments:

Table 2: Soil test results for the Mannanarie paddock

Zone	Depth	Organic Carbon	Conduct-ivity	pH Level (CaCl2)	pH Level (H2O)	Exc. Ca	Exc. Mg	Exc. K	Exc. Na	ESP (%)	Boron Hot CaCl2
		%	dS/m	pH	pH	meq/ 100g	meq/ 100g	meq/ 100g	meq/ 100g		mg/Kg
High	0-10	0.82	0.064	5.10	6.00						
	0-30		0.162	7.00	7.80	16.66	6.99	1.00	1.59	6.1	1.80
	30-60		0.223	7.50	8.30	18.67	6.83	0.80	1.74	6.2	1.70
	60-80		0.716	7.70	8.20	16.08	9.07	0.88	4.01	13.3	5.20
Low	0-10	1.28	0.095	5.40	6.20						
	0-30		0.143	7.10	8.10	11.35	8.04	0.96	2.64	11.5	6.30
	30-60		0.139	7.30	7.90	16.92	8.29	0.95	1.03	3.8	1.60
	60-80		0.175	7.70	8.60	18.12	8.19	0.75	1.30	4.6	1.70

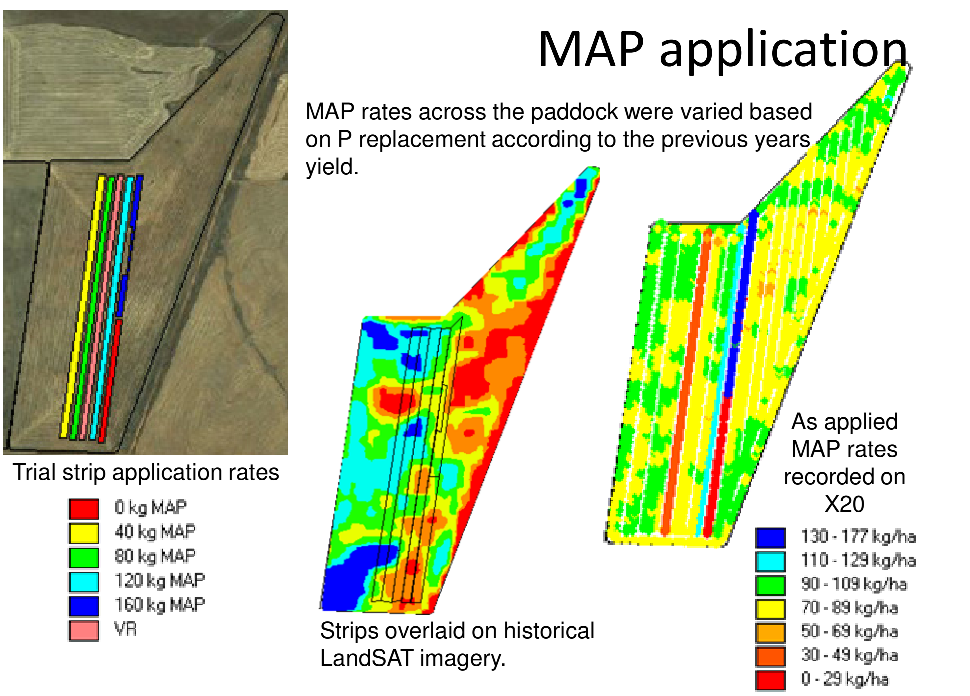
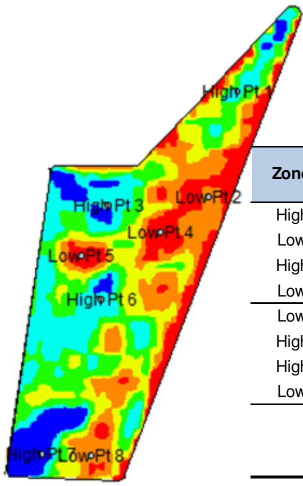


Figure 1: Application rates of MAP strips superimposed on an aerial image of the paddock. This figure is compared with historical LandSAT imagery and information collected by the John Deere X20.

Dom Clark, Shorts Road, Soil Test Results



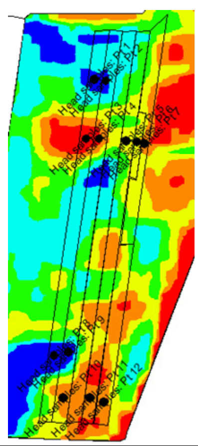
•Soil tests targeted according to historical LandSAT NDVI.

Indicates % of potential biomass and yield attainable at the DGT P level.

Zone	Point	Latitude	Longitude	Colwell P mg/kg	PBI	Critical Colwell P	C_{DGT} µg/L	GS30 257 µg/L	Grain 57 µg/L
High	1	-33.1127	138.6021	46	43	20	159	80	100
Low	2	-33.1155	138.6012	38	36	19	87	66	96
High	3	-33.1157	138.5980	31	35	19	70	61	94
Low	4	-33.1164	138.5997	29	48	21	35	50	78
Low	5	-33.1170	138.5972	43	50	21	72	62	94
High	6	-33.1182	138.5978	36	41	20	75	63	95
High	7	-33.1223	138.5959	39	33	18	87	66	96
Low	8	-33.1223	138.5975	43	46	21	59	58	91
			Average of zones						
			High	38	38	19	98	67	96
			Low	38	45	20	63	59	90

Zone	Depth	Organic Carbon %	Conductivity dS/m	pH Level (CaCl2) pH	pH Level (H2O) pH	Exc. Calcium meq/100g	Exc. Magnesium meq/100g	Exc. Potassium meq/100g	Exc. Sodium meq/100g	ESP (%)	Boron Hot CaCl2 mg/Kg
High	0-10	0.82	0.064	5.10	6.00						
	0-30		0.162	7.00	7.80	16.66	6.99	1.00	1.59	6.1	1.80
	30-60		0.223	7.50	8.30	18.67	6.83	0.80	1.74	6.2	1.70
	60-80		0.716	7.70	8.20	16.08	9.07	0.88	4.01	13.3	5.20
Low	0-10	1.28	0.095	5.40	6.20						
	0-30		0.143	7.10	8.10	11.35	8.04	0.96	2.64	11.5	6.30
	30-60		0.139	7.30	7.90	16.92	8.29	0.95	1.03	3.8	1.60
	60-80		0.175	7.70	8.60	18.12	8.19	0.75	1.30	4.6	1.70

Table 3: Soil test results including Colwell P levels for high and low production zones shown in the map alongside. The circled section of the phosphorus buffering index (PBI) column show a slight difference between the two zones.



Grain nutrient tests (mg/kg)

- Typically wheat grain averages 3 kg P/t.
- In this trial the low zone identified from the satellite data has lower P concentration in the grain.
- This correlates with the lower available P according to the DGT test results in this zone.
- There are no trends between MAP application rate and P levels in the grain.

Head samples	LandSAT zone	MAP rate (kg/ha)	Latitude	Longitude	Fe	Mn	B	Cu	Zn	Ca	Mg	Na	K	P	S
Pt 1	High	40	-33.1159	138.5978	28	58	1.1	4.5	18	290	1220	29	4300	3100	1130
Pt 2	High	80	-33.1159	138.5981	28	45	0.74	4.8	24	310	1230	25	4300	3500	1180
Pt 3	Low	40	-33.1171	138.5976	29	70	0.89	4.0	18	280	1190	22	4100	2800	1170
Pt 4	Low	80	-33.1171	138.5979	37	54	0.95	4.2	20	270	1080	26	3500	2200	1400
Pt 5	Low	120	-33.1171	138.5986	31	44	1.2	4.6	19	270	1070	30	4000	2400	1260
Pt 6	Low	0	-33.1171	138.5988	28	44	1.0	4.2	20	270	1210	30	4200	3100	1080
Pt 7	Low	160	-33.1171	138.599	31	47	1.6	3.9	18	260	1110	24	3800	2300	1150
Pt 8	High	40	-33.1213	138.5969	27	40	0.96	3.8	19	320	1140	16	4500	3100	1110
Pt 9	High	80	-33.1212	138.5972	28	39	1.5	4.4	20	250	1110	22	4300	2900	1100
Pt 10	Low	80	-33.1221	138.5971	29	42	2.2	4.6	22	240	1120	24	3800	2400	1210
Pt 11	Low	120	-33.1221	138.5977	29	55	1.9	4.4	19	230	1200	30	4000	2800	1140
Pt 12	Low	0	-33.1222	138.598	27	62	1.1	4.3	16	260	1070	21	4000	2500	1210
				Average of Zones											
				High	28	46	1.09	4.4	20	293	1175	23	4350	3150	1130
				Low	30	52	1.37	4.3	19	260	1131	26	3925	2563	1203

Table 4: Grain nutrient analysis of the phosphorus response trial in 2010

Dom Clark, Shorts Road, Historical Data

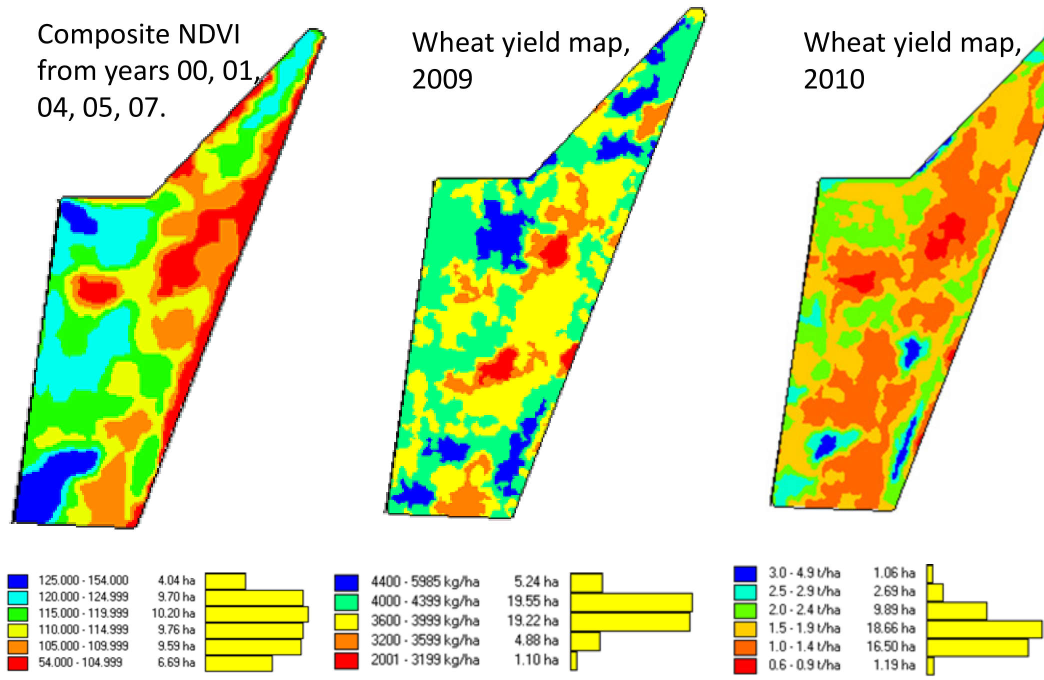


Figure 2: Comparison of 2009 and 2010 yield maps with the composite NDVI map; comprised of data collected from the 2000, 2001, 2004, 2005 and 2007 seasons. There is a strong correlation between all maps, giving confidence that soil variability is the source of yield variation.

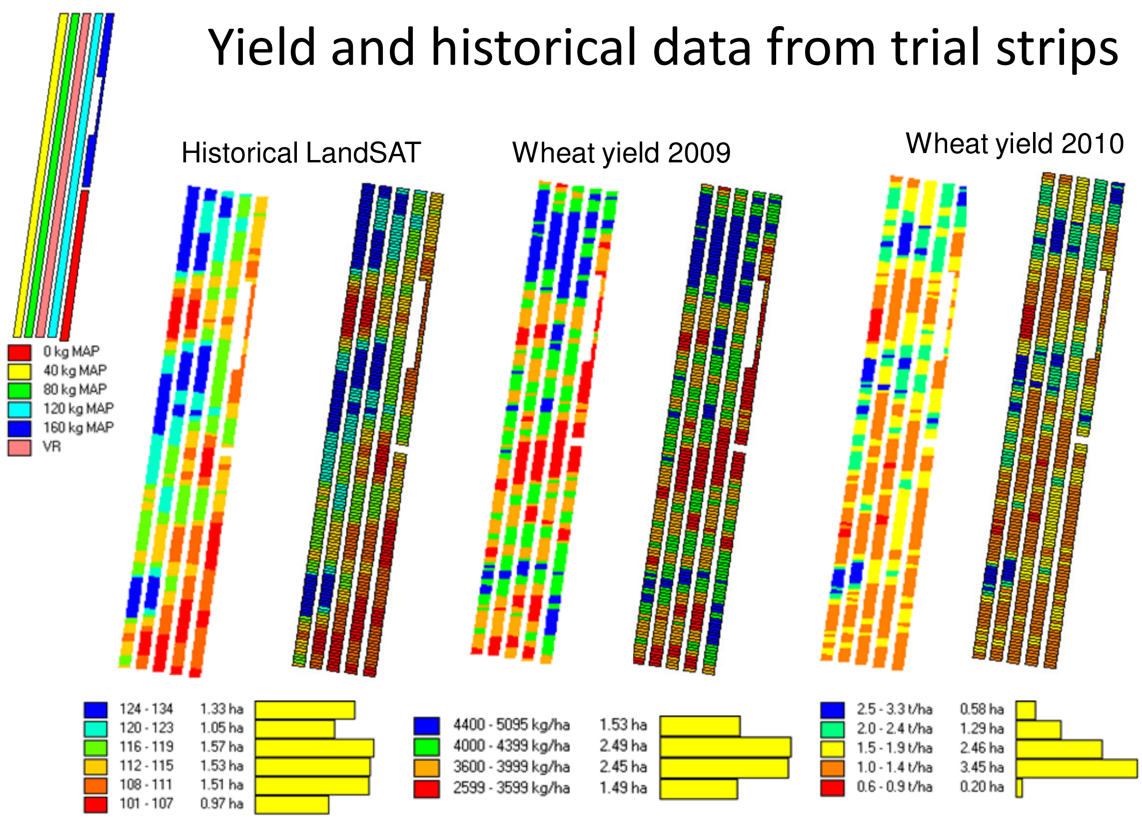


Figure 3: Alignment of yield and historic LandSAT data showing variation in corresponding locations of the paddock.

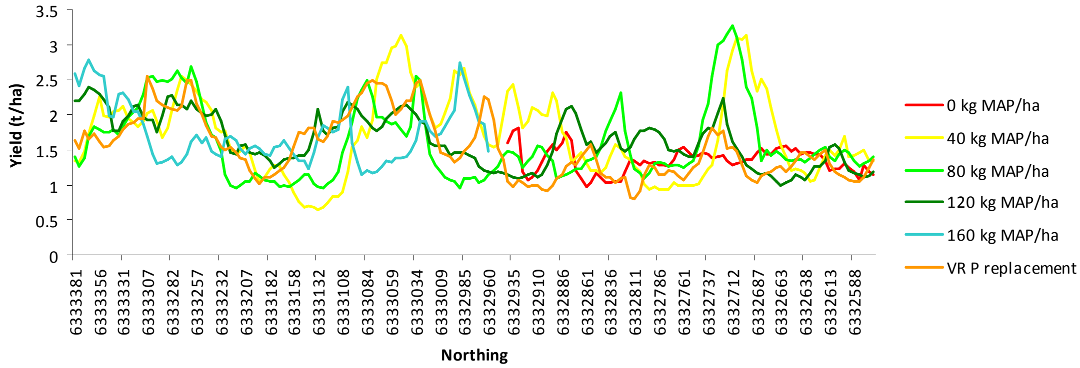


Figure 4: Yield results for the different fertiliser strips sown compared with a replacement rate. The greatest variability in yield occurred with both the 40 kg/ha and 80 kg/ha rates of MAP. The 0 kg/ha and 120 kg/ha MAP rates were less variable.

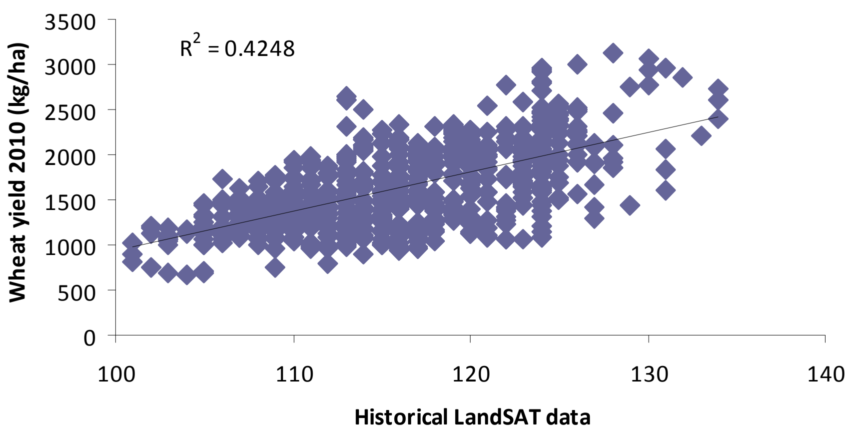


Figure 5: Comparison of historical LandSAT imagery with grain yield for the 2010 season. This graph shows an R^2 value of 0.4248 suggesting that an increase in LandSAT data value will likely see a higher wheat yield. In practice, the measurement of greenness of a crop in-season indicates a crop will likely yield higher at harvest.

What does this mean?

The variation in wheat yield (0.8 – 3 t/ha) with different rates of MAP fertiliser (figure 4) indicates considerable variation across the paddock. Therefore continued application of blanket fertiliser rates across this paddock will mean reduced income for the farmer. This paddock has the potential to increase returns by using variable rate fertiliser application. This is simply applying fertiliser where the crop can use it and reducing inputs in areas that will not respond. Varying fertiliser rates will result in better fertiliser use efficiency and improve the bottom line for farmers with similar soils types and variation across their paddocks.

The Historical LandSAT data appears to correlate well with yield data. The low historical LandSAT values correlate with lower grain yield. Soil tests indicate these ‘low’ areas have higher levels of boron and sodicity at shallow depth (0-30cm) which are likely to limit root growth, crop growth and yield. Soil tests and grain nutrient tests indicate that low production areas are lower in phosphorus; however yield results from the trial are inconclusive. In many cases the differences between treatment strips can be related to their location and the underlying zone, rather than the treatment fertiliser rate.

Who was involved?

Property owner: Dom Clark
Data collection: Charlton Jeisman
Soil analysis: Sam Trengove, Sean Mason
Trials coordinator: Charlton Jeisman
Farming systems group contact: Charlton Jeisman

Grower/Regional feedback:

The grower mentioned the importance of correctly identifying the GPS coordinate locations to get reliable soil type information. Yield maps provided showing areas of the paddock with high and low potential assisted this process. Soil analysis verified the trends produced by the yield map.

This project was funded by the Grains Research and Development Corporation (GRDC) and run in conjunction with the Northern and Yorke Natural Resources Management Board.

For more information

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

PA Group facilitator
Upper North Farming Systems
P: 08 8664 1408
E: charlton.jeisman@sa.gov.au

GRDC Grains Research & Development Corporation