Long-term P trial

Summit Fertilisers
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AIM

To investigate the effect of phosphorus application rates and strategies over a number of years on the growth and yield of wheat.

TRIAL DETAILS

Property:	Alan Manton, Lomos South Road, Yealering			
Plot size & replication:	25m x 6.09m (3 runs 2.03 m wide) in 3 randomised replicates			
Soil type:	Sand to sandy loam			
Crop Variety:	Mace wheat			
Application Date:	At sowing plus split N top-ups post emergence			
Sowing Date:	28 May 2014			
Seeding Rate:	75 kg/ha			
Basal fertiliser (kg/ha):	SOP topdressed 100 kg/ha + UAN 50 L/ha, Cu 200 g/ha and Zn 200 g/ha injected at seeding UAN 60 L/ha at 5 and 8 weeks after seeding (41 kg K/ha, 72 kg N/ha, 17 kg S/ha, 200g Cu/ha, 200g Zn/ha)			
Paddock rotation:	Wheat 2013, 2012, 2011, 2010			
Herbicides:	Pre emergent	Glyphosate	2 L/ha	
		Avadex	2 L/ha	
		Sakura	188 g/ha	
		Diuron	300 g/ha	
	Post emergent	Velocity	1L/ha	(19/08/2014)
		Jaguar	700 mL/ha	(19/08/2014)
Insecticides:	Nil			
Fungicides:	Post emergent	Prosaro	300mL/ha	(19/08/2014)

BACKGROUND

Decreasing P application rates can decrease crop input costs for growers or allow shifting capital to other areas of farm spending. This trail was established to investigate the impact of various P rates on crop production and to determine whether subsequent P applications can change any long-term impact of a decreased application rate.

The trial started in 2010. Phosphorus has been applied at rates from 0 to 30 kg/ha on plots each year to understand the impact of the different rates on crop vigour and growth, grain yield and returns from phosphorus applications. Hence, total P applied ranges from 0 kg/ha to 150 kg/ha over the five years of the trial.

Previous results have been published annually in the Facey Group Trial Results booklets.

METHODOLOGY

Table 1: Phosphorus treatment rates (kg/ha) applied to plots each year 2010 to 2014.

P Tmt	1			2			3			4			5			6		
Year	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	12	0	12	12	6	12	12	12	12	12	18	12	12	24	12	12	30
2013	12	12	0	12	12	6	12	12	12	12	12	18	12	12	24	12	12	30
2012	12	12	0	12	12	6	12	12	12	12	12	18	12	12	24	12	12	30
2011	12	0	0	12	6	6	12	12	12	12	18	18	12	24	24	12	30	30
2010		0			6			12			18			24			30	

Phosphorus was applied as TSP banded at seeding. Current and historical P rates (kg/ha) from 2010 to 2014 are listed above (Table 1).

In 2014 all plots were split with P treatments applied on one half and omitted on the other to compare wheat response across various rates of fresh and residual P from previous years.

RESULTS & DISCUSSION

Topsoil testing showed increasing residual P related to the total amount of P applied since 2010, but levels were not high. (Figure 1)

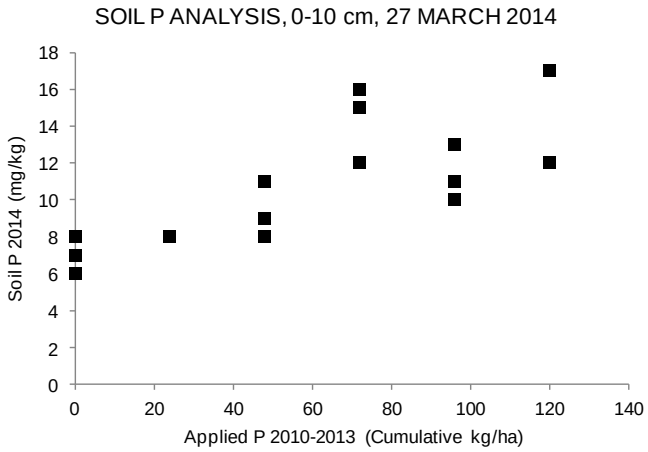

Figure 1: Colwell P analysis of topsoil in treatment plots prior to 2014 sowing. PBI range 9 to 14.

Observations of growth and vigour at 30 July found plots clearly more vigorous where P was applied in 2014 than where P was not applied. This was evident in all treatments, including plots having received 30 kg P/ha consecutively in the past four growing seasons.

Plant weights and vigour differences continued through to harvested grain yields. Yields ranged from a low of 1.51 T/ha with no P applied to a high of 2.67 T/ha at 24 kg P/ha. However, the yield achieved with 6 kg P/ha applied (2.27 T/ha) was not significantly different to any of the higher treatment rates (LSD = 0.51 T/ha)

Yields were higher on plots with greater historical P applications and the increases were greater where fresh P was applied in 2014, and at every P rate. (Figure 2)

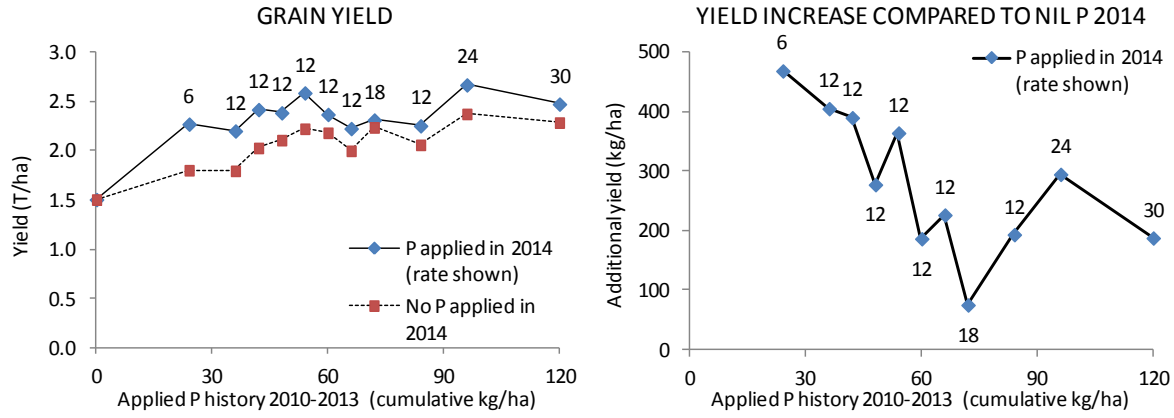

Figure 2: Comparative grain yields showing differences between nil P and P applied in 2014 and proportionately lower yield increases where historic P use is higher.

While yield figures are important, gross margin will indicate the potential grower return from fertilizer treatments. Cost of P nutrition at rates used in the trial ranges from $0 to $98 per hectare. Assuming all other costs being equal between treatments, crude gross margin achieved from 2014 yields can be calculated as below (Table 2).

It is important to note that different margins are indicative only, bearing in mind that yields from application of 6 to 30 kg P/ha, inclusive, showed no significant statistical difference. However, at the low end of application rates, the returns from 6 to 12 kg P/ha are markedly better than where no P was applied.

Table 2: Grower returns after P fertilizer costs.

P rate (kg/ha)	0	6	12	18	24	30
P fert cost ($/ha)	$0	$20	$39	$59	$78	$98
Gross margin* ($/ha)	$476	$698	$715	$630	$766	$686

*Gross margins calculated assuming APW1 delivery grade price 19 December 2014 of $316 per T, and retail list price of P in triple superphosphate at March 2013 of $3.25 per kg.

The impact of different P rates on wheat yield over consecutive years on indicative cumulative grower returns is shown in Table 3. The results highlight a number of important points:

1. The significantly lower yield and return if no P is applied;
2. On a highly P-responsive site there is potential to improve yield in subsequent years by increasing P rates. A lower yield from P limitation will respond well to increased P the following year but not yield quite as well as a crop where P use has been moderate but continuous;
3. The general trend is increasing return up to 12 units of P used consecutively each year, after which the returns level off since continuing yield increases are offset by the increased P costs.

Table 3: Yield and cumulative grower return from various consecutive annual P application rates 2010 to 2014.

P rate (kg/ha)						**Wheat Yield (T/ha)**					**Cumulative**
2010	**2011**	**2012**	**2013**	**2014**	**Sum**	**2010**	**2011**	**2012**	**2013**	**2014**	**gross margin**
0	0	0	0	0	0	0.56	2.42	1.06	2.51	1.51	$ 2,189
0	0	12	12	12	36	0.56	2.42	1.40	3.18	2.16	$ 2,576
0	12	12	12	12	48	0.56	3.19	1.26	2.95	2.20	$ 2,592
6	6	6	6	6	30	0.82	3.21	1.27	3.11	2.27	$ 2,814
6	6	12	12	12	48	0.82	3.21	1.42	3.16	2.20	$ 2,790
6	12	12	12	12	54	0.82	3.43	1.47	3.27	2.42	$ 2,931
12	12	12	12	12	60	0.91	3.41	1.34	3.11	2.39	$ 2,841
18	12	12	12	12	66	1.02	3.67	1.62	3.49	2.59	$ 3,169
18	18	12	12	12	72	1.02	3.42	1.47	3.35	2.30	$ 2,920
18	18	18	18	18	90	1.02	3.42	1.43	3.22	2.18	$ 2,775
24	12	12	12	12	72	1.22	3.64	1.43	3.31	2.37	$ 3,028
24	24	12	12	12	84	1.22	3.65	1.43	3.42	2.23	$ 2,974
24	24	24	24	24	120	1.22	3.65	1.59	3.57	2.67	$ 3,091
30	12	12	12	12	78	1.13	3.39	1.30	3.14	2.23	$ 2,795
30	30	12	12	12	96	1.13	3.65	1.30	3.26	2.25	$ 2,830
30	30	30	30	30	150	1.13	3.65	1.44	3.44	2.48	$ 2,819

The use of split plots in 2014 allows us to quantify the response of wheat to P after a known and controlled history of applications. A dollar return value of a single unit of P can be calculated (Figure 3). The trend shows the diminishing return from a unit of freshly applied P when the P application history is high. Considering the variation in the data, Figure 3

suggests that historical application of a total of around 50 kg P/ha over a four-year period is approaching the break-even point where an additional unit of P will have minimal impact on grower returns the next year. Again, keeping in mind the trial site conditions, soil P stores and low PBI (Figure 1) other sites may respond differently.

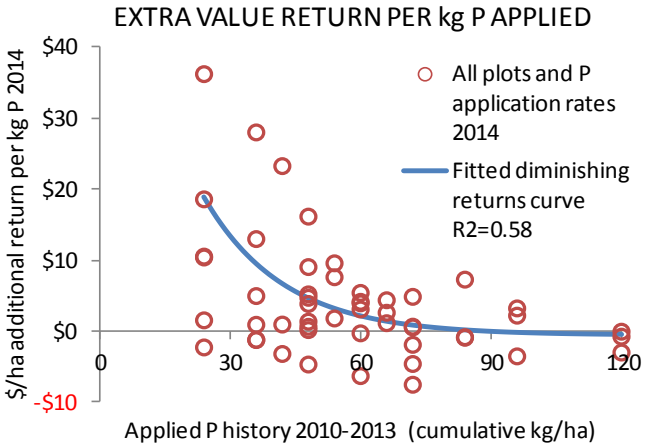

Figure 3: Representation of the value of a single unit of P in terms of improved returns compared with no P applied. Additional returns per hectare are net of P cost.

CONCLUSION

- The value of starter P for early crop vigour was clearly demonstrated in 2014 by the decreased growth of wheat plants when P fertiliser was omitted. This effect continued through the grain development stages and was very evident in the final grain yield differences.
- If P application over the previous four years averaged 12 kg/ha or less, there is a good value return from applying P.
- Although the highest yield was seen at 24 kg P applied in 2014, looking at historical trends shows that continual application of P at greater than 12kg/ha can provide yield gains but little or no margin and should not be considered unless low P application history, confirmed by soil P tests associated with P binding capacity, has resulted in low soil P levels.
- Results indicate a P recommendation of greater than 6 kg/ha to be appropriate for soils and conditions in the vicinity of the trial site, pushing up to 10-12 kg/ha if the input cost is affordable.

ACKNOWLEDGEMENTS

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