



AgGrow

AGRONOMY + RESEARCH



PHOSPHOROUS RESPONSE ON HIGH PHOSPHOROUS SOILS

2014

Ag Grow Agronomy Phosphorous Response Trials

KEY POINTS

- * Phosphorous (P) is one of the major plant nutrients, required for optimum growth and development. Soil tests in the region are commonly showing elevated levels of P, questioning the value of applying P on these soils.
- * P is a nutrient which is affected by soil pH. Where soils are acidic the availability of P is limited, regardless of how high the P level may be in the soil. P also sits close to the surface, especially in long term no till paddocks.
- * Despite high soil P levels, varying responses to P were gained at each of the four trial sites. Even where P levels were very high, Colwell P 78 mg/kg at Barellan, there was a response to increasing rates of applied P.
- * There is a need to apply at least 10kg of P/ha, even in high P paddocks where soils are acidic and where yields are above 2 t/ha.

BACKGROUND

Many soil tests conducted for clients by Ag Grow Agronomy and Research have shown elevated levels of Phosphorous (P).

Levels above 25-30 mg/kg Colwell in the past have been considered adequate. The traditional rule of thumb for applying P has been to apply 4-6kg P/tonne of expected yield. This is proving to increase soil P levels. Measured P levels in grain are close to 2kg P/t grain.

This raises the question - Do we need to evaluate if this is where resources need to be invested, and if traditional P rates are warranted at elevated soil P levels?

TRIAL DETAILS

Four phosphorous response trials were established by Ag Grow Agronomy and Research in 2014.

They were established on high P soils at Michael Pfitzner's, Rankins Springs; Jeffrey Muirhead's, Merriwagga; Jeff Savage's, Barellan and Graeme Horneman's Hillston.

Soil P (Colwell) and pH (CaCl₂) levels for each of the

sites were:

Rankins Springs	44 mg/kg	pH 5.7 CaCl ₂
Merriwagga	23 mg/kg	pH 5.1 CaCl ₂
Barellan	78 mg/kg	pH 4.3 CaCl ₂
Hillston	28 mg/kg	pH 7.8 CaCl ₂

The aim of these four trials was to evaluate the P response on high P (>25 mg/kg Colwell P) soils.

Each trial consisted of 1 variety by 5 P rates (as superphosphate) and was replicated 4 times. 60kg urea was predrilled on the dryland sites, and 200kg urea on irrigation.

The P rates for the dry land trials at Rankins Springs, Merriwagga and Barellan were 0, 2.5, 5, 10 and 20 kg P/ha. The P rates for the irrigated trial at Hillston were 0, 5, 10, 20 and 30 kg P/ha.

The trials were sown with a Morris Contour Drill plot seeder with 25cm row spacings x 7 rows. Plot sizes were 1.75m x 12m.

Further details for each of the trials are shown in table 1.

Table1: P response trials management details

	<u>Merriwagga</u>	<u>Barellan</u>
Previous Crop:	Wheat	Wheat
Pre-sow herbicides:	1L Roundup UltraMax	1L Roundup UltraMax
Pre-em herbicides:	2.5L Boxer Gold + 50g Logran B	118g Sakura + 50g Logran B
Variety:	Lancer	Merinda
Sowing date:	1 st May, 2014	9 th May, 2014
Sowing Rate:	30 kg/ha	40 kg/ha
Nitrogen Fertiliser:	60 kg/ha urea	60 kg/ha urea
Post-em herbicides:	1L LVE MCPA 570 4 th August	300mL Axial + 0.5% Adigor + 1L Precept 150
Post-em fungicides:	500mL Prosaro 4 th August	Amistar Xtra 750ml 9 th September
Harvest Date:	5 th December, 2014	29 th November, 2014
	<u>Rankins Springs</u>	<u>Hillston</u>
Previous Crop:	Fallow	Fallow
Pre-sow herbicides:	2L Roundup UltraMax	1L Roundup UltraMax
Pre-em herbicides:	2.5L Boxer Gold	2.5L Boxer Gold
Variety:	Livingston	Lancer
Sowing date:	22 nd May, 2014	16 th May, 2014
Sowing Rate:	40 kg/ha	100 kg/ha
Nitrogen Fertiliser:	60 kg/ha urea	200 kg/ha urea
Post-em herbicides:	1.5L Precept 150 + 0.5%Adigor 30th July	
Post-em fungicides:	500mL Prosaro 30 th July 250ml Cogito 29 th Sept	Folicur 290ml by air 23 rd Aug Amistar Xtra 800ml 1 st Oct
Post-em insecticide:		Pirimor 150g 1st Oct
Harvest Date:	20 th November, 2014	27 th November, 2014
Irrigations:	N/A	2 spring irrigations (3ML/ha) - Aug and Sept

Figure 1: No Phosphorous (left) v Phosphorous (right) at Merriwagga



RESULTS AND DISCUSSION

Statistical analysis was carried out on grain yield and protein for each of the four trial sites.

Significant differences were found at all four sites for grain yield (Figure 2) and grain N yield, measure of total amount of nitrogen in the grain (Figure 3).

Grain protein for each of the trials is shown in figure 4.

Barellan:

There was a stepped response to grain yield and grain N yield. The 10kg P/ha and 20kg P/ha treatments had a significant response, with the lower amounts of phosphorous (0, 2.5 and 5 kg P/ha) not having a response.

Grain yield averaged 2.19 t/ha, with yields ranging from 1.82 t/ha for the 2.5kg P/ha treatment, to 2.52 t/ha for the 20kg P/ha treatment.

Grain N yield averaged 277.24, ranging from 210.5 for the 2.5kg P/ha treatment to 302.7kg P/ha for the 20kg P/ha treatment.

Grain protein averaged 11.55%, ranging from 11.35%, for the 10kg P/ha treatment to 11.88% for the 20kg P/ha treatment.

Hillston:

Phosphorous applied at 10 kg/ha was higher than phosphorous applied at higher and lower rates for both grain yield and grain N yield.

Grain yield averaged 8.43 t/ha, with yields ranging from 7.75 t/ha for the 30kg P/ha treatment to 9.77 t/ha for the 10kg P/ha treatment.

Grain N yield averaged 1138.8, ranging from 1065 for the 0kg P/ha treatment to 1204.25 for the 10kg P/ha treatment.

Grain protein averaged 13.47%, ranging from 13.33% for the 5kg and 10kg P/ha treatments to 13.6% for the 0kg P/ha treatment.

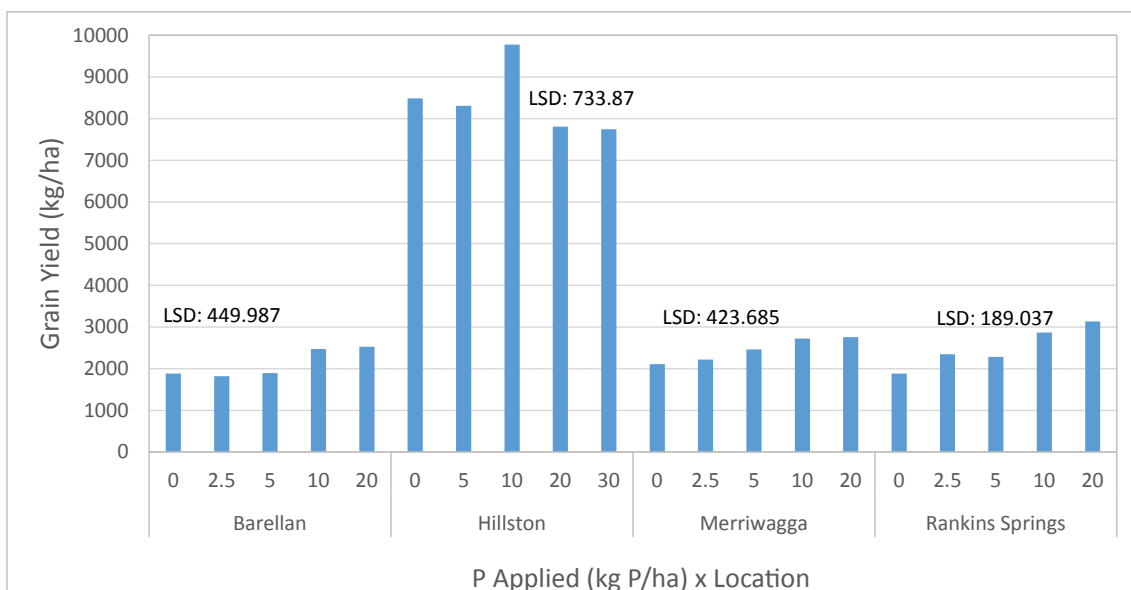
Merriwagga:

Applying phosphorous increased grain yield. It also increased the amount of nitrogen extracted from the soil and increased grain protein.

Grain yield averaged 2.45 t/ha, with yields ranging from 2.11 t/ha for the 0kg P/ha treatment to 2.76 t/ha for the 20kg P/ha treatment.

Grain N yield averaged 222.46, ranging from 193.1 for the 0kg P/ha treatment to 250.2 for the 20kg P/ha treatment.

Figure 2: Grain Yield for each of the four phosphorous response trials.



Grain protein averaged 9.08%, ranging from 8.83%, for the 5kg P/ha treatment to 9.28% for the 2.5kg P/ha treatment.

Rankins Springs:

The Rankins Springs site had a similar response to applying phosphorous to the Merriwagga site.

Grain yield averaged 2.50 t/ha, with yields ranging from 1.88 t/ha for the 0kg P/ha treatment to 3.13 t/ha

for the 20kg P/ha treatment..

Grain N yield averaged 290.98, ranging from 223.9 for the 0kg P/ha treatment to 372.2 for the 20kg P/ha treatment.

Grain protein averaged 11.74%, ranging from 11.5%, for the 5kg P/ha treatment to 12.1% for the 20kg P/ha treatment.

Figure 3: Grain N Yield for each of the four phosphorous response trials.

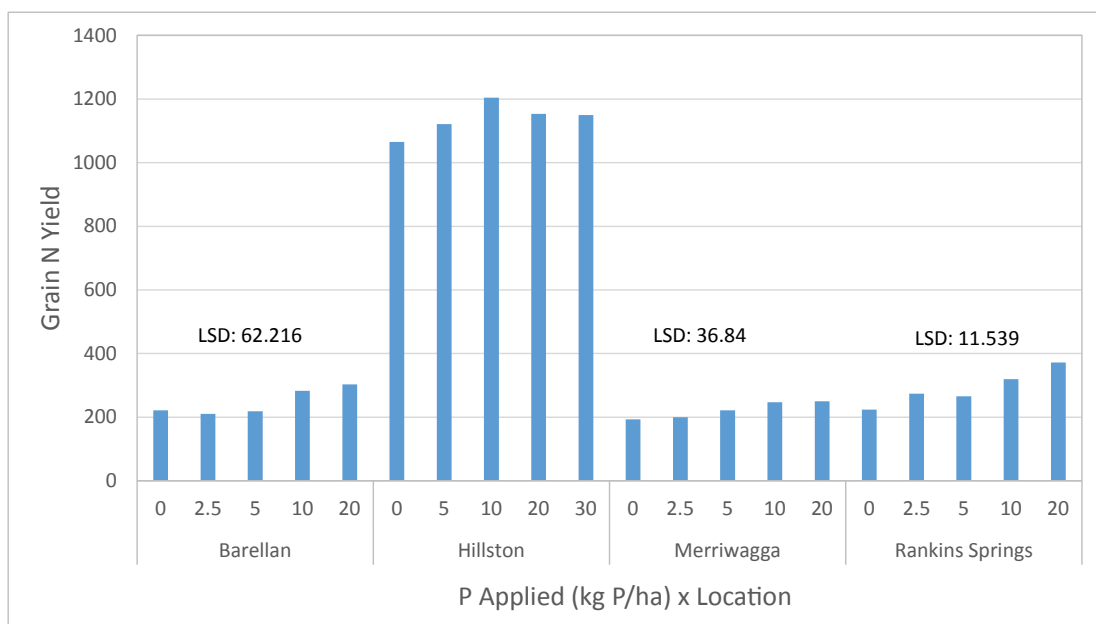
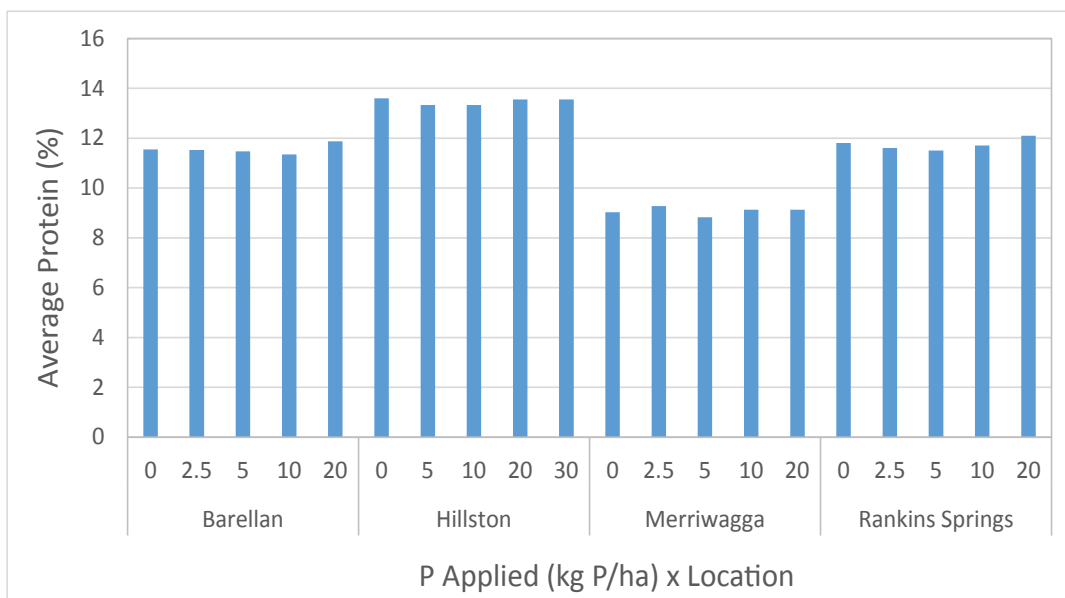


Figure 4: Grain protein for each of the four phosphorous response trials.



Economic Analysis

Return on investment, calculated for each of the four phosphorous response trials, is shown in figure 5.

The highest return on investment and profit for three out of the four trials was where 10kg P/ha was applied. This was for the Barellan, Hillston and Merriwagga sites.

For Rankins Springs the highest profit (\$/ha) was where 20kg P/ha was applied. The highest return on investment at this site was where 2.5kg P/ha was applied. This was closely followed by 10kg P/ha.

Applying 20kg P/ha at Barellan and Merriwagga had the highest yield benefit, but it did not give the highest return on investment.

At Hillston the only treatment which gave a positive grain yield benefit was 10kg P/ha. At higher and lower phosphorous rates there was a negative profit and a negative return on investment.

At Barellan applying less than 10kg P/ha also gave a negative profit and a negative return on investment.

Figure 5: Return on Investment and Profit (\$/ha) for each of the four phosphorous response trials, grain price \$235/t on farm ASW; Phosphorous \$3.50/kg P.

	P Treatment 0kg P/ha	P Treatment 2.5kg P/ha	P Treatment 5kg P/ha	P Treatment 10kg P/ha	P Treatment 20kg P/ha	P Treatment 30kg P/ha
Yield Barellan (kg/ha)	1886	1819	1897	2473	2523	n/a
Yield Hillston (kg/ha)	8488	n/a	8308	9774	7809	7746
Yield Merriwagga (kg/ha)	2111	2217	2460	2725	2758	n/a
Yield Rankins Springs (kg/ha)	1884	2348	2284	2866	3131	n/a
Cost of phosphorous @ \$3.50/kg P	0	8.75	17.5	35	70	105
Cost of Application	0	0	0	0	0	0
Grain Yield benefit Barellan (kg/ha)	0	-67	11	587	637	n/a
Grain Yield Benefit Hillston (kg/ha)	0	n/a	-180	1286	-679	-742
Grain Yield Benefit Merriwagga (kg/ha)	0	106	349	614	647	n/a
Grain Yield Benefit Rankins Springs (kg/ha)	0	464	400	982	1247	n/a
Profit Barellan (\$/ha)	0	-\$24.50	-\$14.92	\$102.95	\$79.70	n/a
Profit Hillston (\$/ha)	0	n/a	-\$59.80	\$267.21	-\$229.57	-\$279.37
Profit Merriwagga (\$/ha)	0	\$16.16	\$64.52	\$109.29	\$82.05	n/a
Profit Rankins Springs (\$/ha)	0	\$100.29	\$76.50	\$195.77	\$223.05	n/a
Return on Investment Barellan	0%	-280%	-85%	294%	114%	n/a
Return on Investment Hillston	0%	n/a	-342%	763%	-328%	-266%
Return on Investment Merriwagga	0%	185%	369%	312%	117%	n/a
Return on Investment Rankins Springs	0%	1146%	437%	559%	319%	n/a
Average Grain Yield Benefit (kg/ha)		167.67	145	867.25	463	-742
Average Profit (\$/ha)		30.65	16.575	168.80	38.81	-279.37
Average Return on Investment (%)		350%	95%	482%	55%	-266%

Figure 6: Harvesting at Merriwagga



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