

Selecting a wheat and barley variety for phosphorus efficiency or yield potential – which one is the winner?

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Key Findings

- Higher P rates (more than typical replacement P rates) were required on sites with moderate to high PBI values.
- There were no significant trends in P use efficiency between wheat and barley varieties selected.
- Variety choice should be made on yield potential and not any potential savings from growing a P efficient variety.

Why do the trial?

Phosphorus (P) deficiency still occurs in many regions across SA with major yield limitations occurring due to inadequate applications of P. Low soil P test values are commonly associated with soils that have moderate to high P buffering indices (> PBI 100). In these soil types replacement P programs may not be sufficiently accounting for the low fertiliser recoveries, generating inadequate P replacement rates. In some cases application rates > 40 kg P/ha might be required to maximise yields, a fertiliser rate that under some circumstances might not be the most economic if yields are low. Identifying these sites and assessing under which circumstances (yield potential, fertiliser prices) high rates of P are economical will be valuable to the grains industry.

Wheat and barley varieties may vary in their responsiveness to P either by having root traits that increase access to soil P or by more efficient use of the P that is taken up. In combination with different yield potentials external P requirements and phosphorus use efficiency (PUE) could vary. Identifying varieties that have greater PUE in deficient soil may benefit SA growers, due to the relatively low P levels driven by moderate to high P fixing soils in many regions.

This article summarises two years of P response trials located in three different locations each year.

How was it done?

Replicated (four) P response trials were performed at three different locations in both 2015 (Cummins, Pinery and Sherwood) and 2016 (Condowie, Cummins and Urania). Six different rates of P as MAP (0, 5, 10, 20, 30, 50 kg P/ha) were sown with the seed. Extra nitrogen (N) applied with greater MAP rates was balanced with urea so all treatments had the equal amount of N at sowing. The P response of four different wheat (Cobra, Corack, Mace and Trojan) and barley (Commander, Compass, Fathom, LaTrobe) varieties were tested. Trials were maintained (weeds, top up N) in order to try and match maximum yield potentials. Trials in both years were sown between 21st May and 2nd of June.

Results and discussion

Soil test results for each site are presented in Table 1. Most sites were expected to be responsive to applications of P with the higher PBI sites generally having lower available P levels as measured by DGT. The Sherwood site was the exception, this site did not have a history of cropping and therefore previous P inputs had been low. Unfortunately, the 2016 Cummins site had levels above critical values and therefore not expected to be responsive. However, the 2015 Cummins site also had levels that suggested P was adequate, but the site varied considerably with available P values and was highly responsive in parts.

Table 1. Summary of soil P characteristics at each of the six sites. Critical values for DGT is 56 (marginal = 48-67) for wheat and 68 (marginal = 50-94) for barley.

Site	Year	Crop	PBI	Critical Colwell P (mg/kg)	Colwell P (mg/kg)	DGT P (□g/L)
Cummins	2015	Barley	59	22	25	71
		Wheat	43	22	26	81
Pinery	2015	Barley	135	29	28	17
		Wheat	135	29	31	14
Sherwood	2015	Barley	41	22	17	25
		Wheat	39	22	11	16
Condowie	2016	Wheat	146	29	29	26
		Barley	147	29	22	15
Urania	2016	Wheat	142	29	37	40
		Barley	118	22	36	59
Cummins	2016	Site	54	22	37	77

2015

Yields varied between the three locations with favourable growing conditions at Cummins resulting in yields reaching 7 t/ha. Tough finishes from a warm and dry September/October at Pinery and Sherwood resulted in lower yields, but still relatively high amounts of P were required to produce optimal yields. The economical rates matched the optimal P rates at Cummins and Sherwood but a flat response curves at Pinery saw economical rates drop back to around 30 kg P/ha compared to rates > 50 kg P/ha required to maximise yield. There was no standout in terms of wheat or barley variety across the three sites as the highest yielding varieties changed depending on location. There was no P x variety interaction which means the variety most suited to that particular region will produce the highest yields and should be the variety of choice.

Table 2. Summary of the 2015 grain yield results at each site for the four wheat and barley varieties sown. Shaded varieties returned the highest economical net return (\$/ha) when P deficiency was alleviated.

Location	Variety	Yield (0P) t/ha	Yield (Max.) t/ha	Yield increase with P t/ha	Optimal P rate (kg/ha) yield	Optimal P rate (kg/ha) economic
Cummins	Cobra	5.07	6.15	1.08	6	10
	Corack	5.38	6.35	0.97	12	15
	Mace	4.99	6.18	1.19	26	26
	Trojan	5.42	6.43	1.01	50*	40
	Commander	4.30	6.16	1.86	19	21
	Compass	5.50	7.09	1.59	34	34
	Fathom	5.05	6.38	1.33	22	24
	LaTrobe	5.39	6.71	1.32	18	22
	Pinery	Cobra	2.19	2.99	0.80	55*
Corack		2.66	3.58	0.92	55*	30
Mace		2.45	3.35	0.90	55*	30
Trojan		2.5	2.81	0.31	55*	0
Commander		2.40	3.20	0.80	22	20
Compass		2.82	3.88	1.06	55*	34
Fathom		2.78	3.68	0.90	46	28
LaTrobe		2.94	3.95	1.01	46	50
Sherwood		Cobra	0.23	0.74	0.51	14
	Corack	0.16	0.87	0.71	14	16
	Mace	0.35	1.19	0.84	37	26
	Trojan	0.03	0.59	0.56	21	16
	Commander	0.32	1.05	0.73	21	18
	Compass	0.59	1.66	1.07	55*	34
	Fathom	0.76	1.41	0.65	10	12
	LaTrobe	0.64	1.23	0.59	19	16

2016

The recent growing season produced excellent yields across all three sites with maximum yields reaching nearly 7 t/ha at Condowie, 8 t/ha at Cummins and 9.5 t/ha at Urania. There were some contrasting variety performances compared to the 2015 season. In particular the cool/wet finish to the season was favourable for Trojan yields at both Condowie and Urania.

LaTrobe barley performed well at all three sites. Unfortunately, the Cummins site was not responsive to applications of P. At Condowie higher than normal replacement rates were required to maximise yields and these rates were economical. Lower P rates were required at Urania due to the higher P status of this site. As with 2015 there was no interaction between P rates and varieties and therefore the variety that returned the highest yield was the most profitable.

Table 3. Summary of the 2016 grain yield results at each site for the four wheat and barley varieties sown. Shaded varieties returned the highest economical net return (\$/ha) when P deficiency was alleviated.

Location	Variety	Yield (0P) t/ha	Yield (Max.) t/ha	Yield increase with P t/ha	Optimal P rate (kg/ha) yield	Optimal P rate (kg/ha) economic
Condowie	Cobra	5.21	6.64	1.43	55	42
	Corack	4.14	4.96	0.82	33	21
	Mace	4.58	5.64	1.06	46	28
	Trojan	5.64	6.88	1.25	55	34
	Commander	4.21	5.13	0.92	13	15
	Compass	4.38	5.42	1.04	55	50
	Fathom	4.26	5.50	1.24	14	17
	LaTrobe	4.57	5.85	1.28	37	30
Cummins	Cobra	5.24	6.11	0.87	Site was not responsive to applications of P	
	Corack	5.59	5.50	0		
	Mace	5.92	6.39	0.47		
	Trojan	5.93	5.65	0		
	Commander	6.38	6.55	0.17		
	Compass	7.53	7.54	0.01		
	Fathom	7.89	7.85	0		
	LaTrobe	7.21	7.94	0.73		
Urania	Cobra	8.55	9.58	1.03	55*	30
	Corack	7.01	7.86	0.85	37	23
	Mace	7.55	8.13	0.58	5	6
	Trojan	8.87	9.34	0.47	20	12
	Commander	6.71	7.31	0.60	41	18
	Compass	6.34	6.98	0.64	16	13
	Fathom	7.46	7.66	0.20	NR	2
	LaTrobe	6.68	7.12	0.44	19	12

For more information:

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