Phosphorus Recovery Trials 2008

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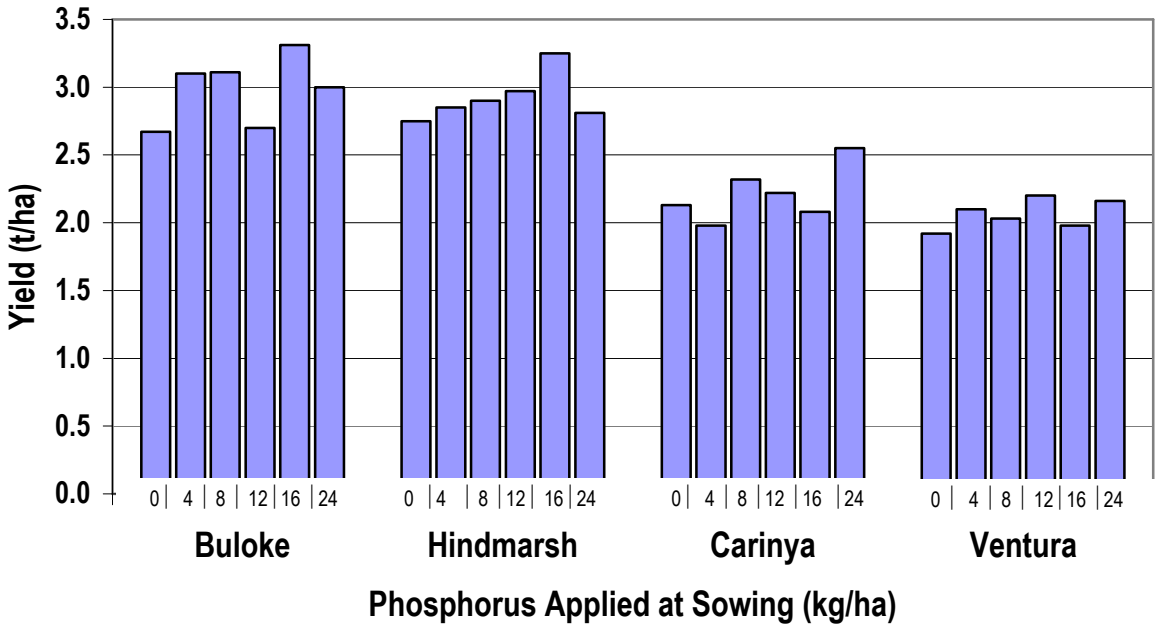
With the rapid rise in the cost of Starter phosphate fertilisers and three consecutive years of drought the discussion amongst farmers across the Central West region is focused upon reducing cropping costs and the potential to recover phosphorus (P) applied in previous years, when total crop failure was a widespread phenomena across this district. CWFS established several trials across the region in 2008 to evaluate the potential to recover previously applied P in 2007; two were established in the West Wyalong district, at Ungarie and Weethalle. I also encourage you to read the 2008 reports for Nyngan and Rankins Springs trials in the compendium.

The data and trends produced from the two sites were different due to contrasting soil moisture levels at sowing and the in-crop rainfall. Both sites had at least 10 to 15kg residual phosphorus per hectare from super applied from the two previous seasons. The Ungarie trial was sown on the 14 May, while Weethalle was sown 23 June.

When wheat and barley variety trials are sown at the same site and on the same day, it is common for the barleys from June sowings to out yield wheats by 20%. Please check the Ungarie variety trials in the compendium – mean barley yield was 2.8t/ha compared to 2.1t/ha for the mean wheat yield. There are reports or folklore that barleys sown without P are believed to still produce yields 20% higher than the wheats sown with P.

The data produced from the Ungarie site was consistent with previous post-drought P trials going back as far as 1982/83, showing a flattish water-limited yield response. The first thing one notices from the graph below is the two barleys Buloke and Hindmarsh are significantly better at scavenging phosphorus from the soil (as reflected by the yield response) than the two wheats, Carinya and Ventura.

Figure 1. Ungarie: Cereal Yield Response to Applied & Residual Phosphorus 2008.



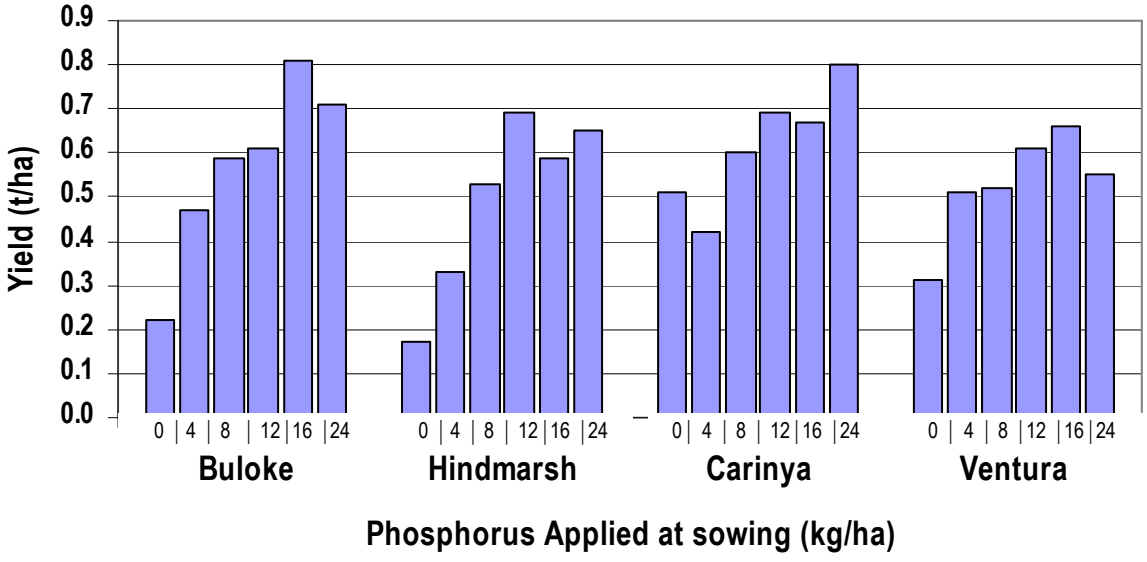
The Ungarie demonstration showed that both Buloke and Hindmarsh with nil P applied at sowing attained yields close to the fertilised barley treatments and out-yielded the wheats, even when the wheats had high rates of P applied at sowing. This demonstration has offered some useful data that supports the belief that barleys are significantly better nutrient scavengers than wheat. Maybe it should be researched further.

Previous trials over the past 25 years have shown that not supplying 5kg P/ha (or 25kg MAP per ha), commonly results in wheat yields that are 10% lower than fertilised treatments. The Ungarie wheat results are very typical of previous trials where once a small amount of P (4kg/ha) has been applied to stimulate early root growth to find the residual P reserves, increasing the P application doesn't economically increase yield beyond the mean yield of the variety as yield is constrained by available moisture. It pays to apply 5kg P/ha at sowing, but you cannot justify spending $72.00/ha on 12kg P/ha (60kg MAP/ha) to only increase yield by 0.2t/ha. With barley at $200.00/tonne farm gate, 0.2t/ha is worth $40.00/ha of grain which covers a little over half the cost of the super.

The Weethalle site produced an atypical trend. The results from Weethalle shown in Figure 2 are little unusual and the graphs exaggerated by the scale, suggesting that as more P is applied the grain yield is increased in a linear response, which is typical of a P deficient soil. The Weethalle site was a low yielding site due to severe moisture stress. Note: We could not justify harvesting the barley and wheat variety trials at this site and the pulse and canola trials failed completely due to moisture stress.

The moisture stress was very severe during the seedling and vegetative growth stages, limiting P absorption and crippling yield potential. This graph indirectly highlights how important phosphorus is to early root development and the capture of moisture by those roots rather than a normal yield response to applied and residual P post-drought.

Figure 2. Weethalle: Cereal Yield Response to Applied & Residual Phosphorus 2008.



Also, notice the barley yields were relatively poor compared to the wheats at this site, while the barley protein levels are one to two percent higher than the wheats. There are some unusual interactions occurring at this site and they are not necessarily obvious. Many of you would be surprised to discover the fertilised barleys harvested more nitrogen than the fertilised wheats, see Figure 3. In spite of the very dry conditions, Hindmarsh and the wheats produced very good quality grain, see Table 2.

Figure 3. Weethalle: Nitrogen Harvested in Grain for Applied P Treatments 2008.

Variety	Mean Yield kg/ha	Mean Grain Protein	Mean Grain Nitrogen kg N/ha
Buloke	640	16.0%	17.9
Hindmarsh	560	15.8%	15.5
Carinya	630	14.0%	15.4
Ventura	570	14.8%	14.8

With an average yield of 0.6t/ha, the P removed in grain or P demand is only 3kg of P per hectare. The volume of residual P available in the soil should have produced a flat water-limited yield responsive result, as it did at Ungarie. August at Weethalle was very dry and the September rain event was late in the third week, see Table 2.

The data in Figure 2 appears to show a linear yield response trend to P, but if that assumption is correct, then to apply 12kg P/ha (60kg MAP/ha) to lift yield of the nil treatments from 0.2 to 0.6t/ha should be a reasonable response. It is not from both an agronomic and economic view. If this was a low P site and average climate conditions prevailed, then by applying 12kg P/ha you would intend to attain a potential yield of 2.5 to 3.0t/ha, which is the average for this district and not just the 0.4t/ha achieved in this trial.

To spend $75.00/ha on MAP to increase yield by 0.4t/ha when wheat is $250.00/t farm gate, the $75.00/ha in grain gain is just equal to the cost of the super used. You should not invest money in an enterprise just to break-even. Prior to 2003, the average local farmer spent $100.00 per hectare to produce a 2.0t/ha wheat crop and with a APW price of $150.00 per hectare, he was tripling his investment.

That linear yield x P response “curve” in Figure 2 really highlights the trial suffered from severe moisture stress during the seedling and vegetative stages and again in mid-September, just prior to flowering. Such a linear yield response to applied P to cereals post-drought is atypical in this region particularly when there is ample residual P available and the rain limited yield potential is likely to be less than 2.5t/ha.

An interesting feature of the wheat entries at both sites was where the Carinya had no P applied at sowing there was a prominent delay in maturity – by a week or so. This is a common response in some wheat varieties, which is why you should have two or more varieties in a trial to rule out varietal anomalies. Ventura's maturity did not appear to be affected although its yield was disappointing. There was an expectation that such a delay in Carinya's maturity may have resulted in a significant increase in screenings but that was not evident in the grain samples (see Table 2).

Following a drought, wheat and barley yield potentials are likely to be less than 2.5t/ha in this district, even if we were to get 40mm per month, from May to October. So provided the soil Al level is below 5.0% exchangeable and that there is a residual P pool of at least 10kg P/ha, then with as little as 25kg MAP per hectare applied at sowing, the crops are likely to reach their rain limited yield potential and produce the best economic outcomes.

Table 1. Ungarie: Cereal Yield Response to Applied & Residual Phosphorus 2008.

Cooperator: Graeme Mason, "Westcourt", UNGARIE.
Paddock History: Fallow 2007, Oats 2006, Oats 2005.
Sowing Date: 14 May 2008 **Harvest Date:** 17 November 2008
Sowing Rate: 50kg seed/ha

Monthly Rainfall 2008 (mm)												Total (mm)
J	F	M	A	M	J	J	A	S	O	N	D	
36	86	29	19	6	38	29	33	13	20	42	35	382

kg/ha P	Yield t/ha	Protein %	Test Wt. kg/Hl	Screenings %
Buloke				
0	2.67	11.9%	66	4%
4	3.10	11.4%	66	3%
8	3.11	11.1%	67	4%
12	2.70	11.4%	67	5%
16	3.31	11.7%	67	5%
24	3.00	11.2%	66	4%
Hindmarsh				
0	2.75	10.8%	69	6%
4	2.85	11.0%	67	4%
8	2.90	11.0%	67	3%
12	2.97	11.1%	68	5%
16	3.25	10.4%	67	4%
24	2.81	11.3%	67	7%
Carinya				
0	2.13	11.6%	79	3%
4	1.98	12.0%	75	3%
8	2.32	11.6%	75	3%
12	2.22	11.7%	76	3%
16	2.08	11.7%	79	3%
24	2.55	11.7%	78	3%
Ventura				
0	1.92	12.1%	75	4%
4	2.10	12.2%	72	5%
8	2.03	12.3%	78	4%
12	2.20	11.4%	74	5%
16	1.98	12.3%	75	4%
24	2.16	12.1%	78	4%

Table 2. Weethalle: Cereal Yield Response to Applied & Residual Phosphorus 2008.

Cooperator: Paul McKinnon, "Labertouche", WEETHALLE.
Paddock History: Wheat 2007, Lucerne 2006, Lucerne 2005.
Sowing Date: 25 June 2008 **Harvest Date:** 1 December 2008
Sowing Rate: 50kg seed/ha

Monthly Rainfall 2008 (mm)												Total (mm)
J	F	M	A	M	J	J	A	S	O	N	D	
41½	53	0	18	0	38	33	13	21½	21½	12	35	286½

kg/ha P	Yield t/ha	Protein %	Test Wt. kg/Hl	Screenings %
	Buloke			
0	0.22	15.7%	64	9%
4	0.47	15.9%	64	10%
8	0.59	16.1%	65	9%
12	0.61	16.2%	63	26%
16	0.81	15.9%	65	9%
24	0.71	16.1%	65	10%
	Hindmarsh			
0	0.17	15.3%	68	5%
4	0.33	15.7%	68	3%
8	0.53	15.5%	68	1%
12	0.69	15.5%	68	1%
16	0.59	16.1%	69	4%
24	0.65	16.4%	68	4%
	Carinya			
0	0.51	13.0%	78	6%
4	0.42	13.3%	80	4%
8	0.60	14.0%	80	4%
12	0.69	14.1%	81	4%
16	0.67	14.1%	80	3%
24	0.80	14.6%	80	4%
	Ventura			
0	0.31	13.2%	80	5%
4	0.51	14.2%	80	6%
8	0.52	14.8%	80	4%
12	0.61	15.0%	80	5%
16	0.66	15.0%	78	5%
24	0.55	15.2%	79	5%