GOA Trial Site Report

Can phosphorous rates on wheat be reduced when late sowing into limited soil moisture?

Trial code:	GONU02118-3
Year:	Winter, 2018
Location:	'Glenaroo', Fifield NSW
Trial partners:	Gordon Larkins

Keywords

GONU02118, wheat, nutrition, phosphorous, drought, yield limited, limited soil moisture, Fifield

Key findings

- Yields increased with increasing rates of phosphorus (P).
- Protein levels were high with all treatments.
- The P rate had no effect on protein levels.
- Screenings increased with increasing rates of P.
- The highest rate of net return was with a P rate of 15 kg/ha.

Background

The 2018 year was one of the driest seasons on record in Central Western NSW. As the season progressed, many farmers were faced with:

1. A significantly shorter season
2. Marginal soil moisture profiles
3. A forecast for less than average rainfall.

All of which would contribute to a greatly reduced yield potential for any crop sown under these conditions, as such farmers were asking the question whether it would be feasible to cut back phosphorous (P) rates at sowing to reduce costs without limiting yield.

Phosphorous is a key requirement early in the crop development, typically greatest during the 6 weeks after sowing. Limited availability of P during this period is likely to slow plant development and hence further reduce the yield potential of the crop. It is also understood that P is not used in year one is generally available for subsequent crops. The decision process is further complicated as each farmers situation is different depending on the inherent and residual levels of soil P, the planting system used (drill v disk) and whether controlled traffic is being used.

Past experience[1] has shown that the requirement for P early in the crop development is about 1 kg/ha, but it needs to be close to the seed and emerging roots. Subsequent P requirements mirror biomass

[1] GRDC Wheat Grownotes – Northern Region

accumulation in the order of 5 kg P per 1 t/ha grain yield potential, and this is typically sourced from wherever the roots are active within the profile (i.e. where there is moisture).

Trials conducted in 2003 in Victoria[2] found that there were considerable yield reductions by delaying sowing (from May to June to July), however, across the 2 sites there was little to no P response at any of the timings. This may have something to do with the sites having reasonable P levels prior to the trial (as subsoil P was not tested, the 0-10 cm layer was tested). In contrast research in Western NSW[3] in 1993 found that later sowing required higher levels of P fertiliser to achieve the same yields as earlier plantings, however, these plantings were conducted early in the sowing window (April compared to May) and not necessarily under drought conditions.

Aims

- Validate current recommendations for P requirements following a drought year, either low yielding or crop failure, for both yield and grain quality.
- Determine by how much P rates may be able to be reduced after a crop failure in the following crop.

Methods

- Small plot, randomised complete block split design, 6 replicates.
- Treatments: 6 rates of P: 0, 5, 10, 15, 20 and 40 kg/ha as triphos.

Results were analysed by Analysis of Variance (ANOVA) and results compared by using Least Significant Difference (LSD) method with a 95% confidence interval. Any references to differences between treatments should be assumed to be statistically different unless otherwise stated. The ANOVA and LSD tests are used to measure the difference between the averages. A statistically significant difference is one in which we can be confident that the differences observed are real and not a result of chance. The statistical difference is measured at the 95% level of probability or confidence unless otherwise stated.

Table 1. Trial site details

Establishment date	Winter 2018		
Crop and variety	Wheat, Spitfire⍵	**Seeding rate**	60 kg/ha
Sowing date	6/7/2018	**Harvest date**	10/12/2018
Seedling equipment	Knife point, press wheel	**Row spacing**	27.5 cm
Crop nutrition (kg/ha)	n/a	**Soil type**	Red kandosol
Previous crop	Canola	**Pre-sowing stubble management**	Direct drilled
Soil nutrition at sowing	Colwell P 16 ppm, Sulphur 14 ppm	**Nitrogen**	0-10cm ~ 40 kg/ha, 10-90cm ~ 72 kg/ha

[2] https://www.farmtrials.com.au/trial/13734
[3] http://www.publish.csiro.au/an/EA97104

Table 2. Fifield rainfall for 2018 versus the long-term average (LTA).

Fifield rainfall													
Month	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**TOTAL**
2018	10	31	0	3	4	42	0	8	16	65	73	110	362
LTA	57	50	49	35	40	36	36	34	35	44	45	47	508

Results

The full results are listed in the attached annex.

Vegetation index:

Plant vigour was assessed using a handheld Green Seeker which determined an average Normalised Difference Vegetation Index (NDVI) for each plot.

The NDVI increased by 19% by adding 20 kg/ha P (**Figure 1**), with no significant difference by adding an additional 20 kg/ha (total rate of 40 kg/ha).

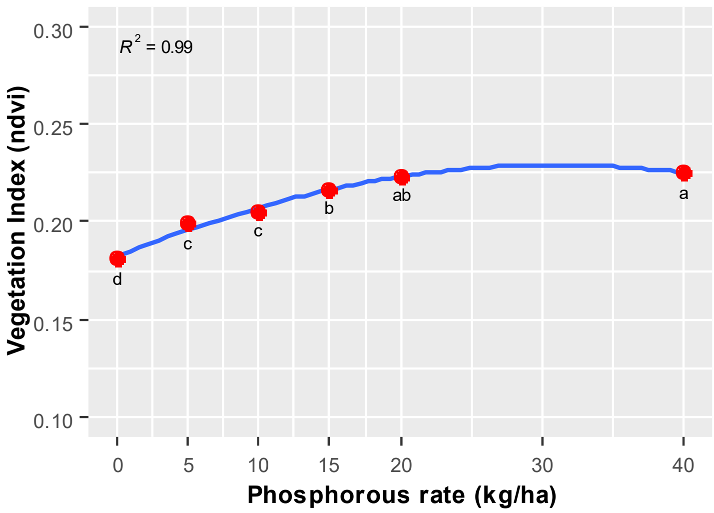

Figure 1. Vegetation index in response to increasing rates of P fertiliser. Assessed 67 days after sowing (DAS). Treatments with the same letter are not significantly different.

Yield

- Yields increased with increasing rates of applied P (**Figure 2**).
- Where no P was applied, the yield was limited to <100 kg/ha.
- Adding 5kg/ha P increase yields to >250 kg/ha, while a further 10 kg/ha (total of 15 kg/ha), increased yields to ~400 kg/ha.
- The higher P rates did not increase or decrease yields.

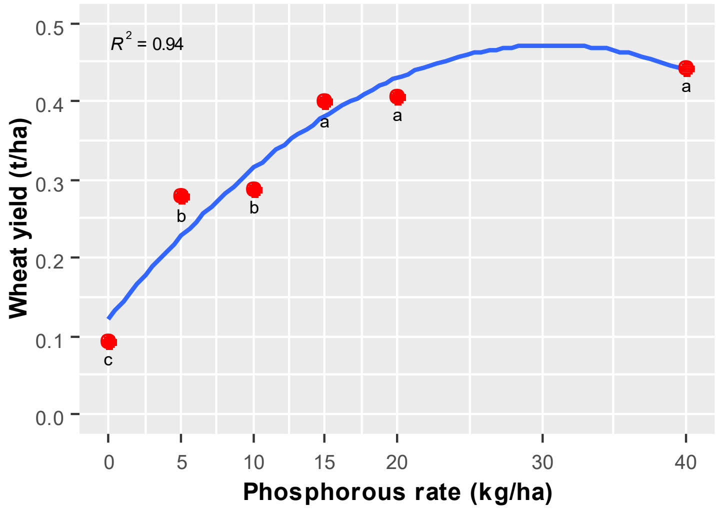

Figure 2. Wheat yields in response to increasing rates of P fertiliser. Treatments with the same letter are not significantly different.

Protein

- Protein levels were high with all treatments >19% with no statistical differences between them.

Screenings

- Screenings were high with all treatments being >5% (**Figure 3**).
- Where 40 kg/ha of P was applied the screenings were 10.3%.
- Where no P was applied, screenings were 8.5%.

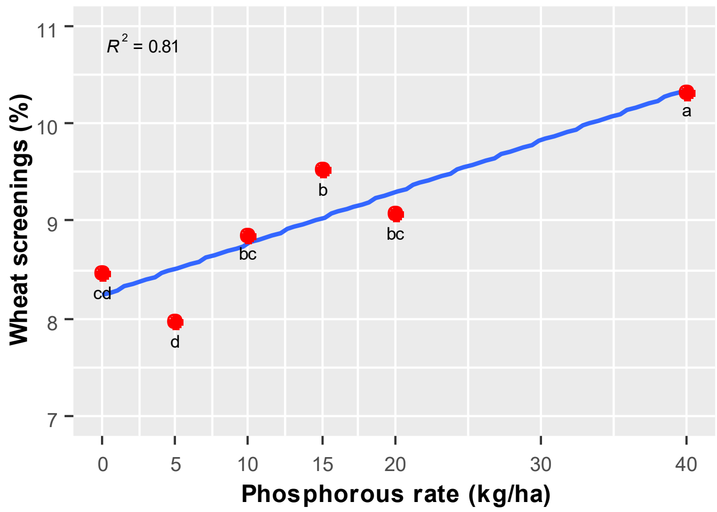

Figure 3. Wheat screenings in response to increasing rates of P fertiliser.

Discussion

This paddock was sown very late in the 2018 season at the beginning of July, well outside the recommended sowing window for the short season, wheat variety Spitfire⦶.

Rainfall was well below average (**Table 2**), prior to sowing approximately 170 mm fell in the fallow (and about half of this before Christmas). The in-crop rainfall was ~160 mm, well below the average of 260 mm[4].

Starting P levels in this paddock (16 ppm in the top 10 cm) were low and at a level where a P response could be expected. The grower generally applies around 70-75 kg/ha MAP (15-16 kg/ha P) annually.

In this trial, reducing P rates from 15 down to 10 and 0 kg/ha resulted in a 27 and >75%% reduction in grain yield respectively. However, increasing P rates from 15 to 40 kg/ha did not further improve yields.

Screenings were high, >8%, and increased with increasing rates of P. Screenings at the highest P rate, 10.3% would have resulted in a further quality downgrading. The P rate had no effect on protein levels.

The VI assessment, taken ~2 months after sowing, showed an early crop growth trend that was reflected in yields. This trend highlighted the importance of P for early crop growth, and the influence P and early plant growth has on the final crop yield. The VI was not a good predictor of screenings, as excessive growth was not detected with the top rate of P treatment, which can be associated with a high grain screenings.

2018 was an extremely dry season and even the highest yielding treatments (~0.4 t/ha) were unlikely to be profitable. Using a simple economic analysis comparing yield increases and accounting for fertiliser costs and grain quality, show that reducing P rates would have resulted in an even lower net return. If no P was applied income would have been reduced by ~$90/ha when compared with applying a rate of 15 kg/ha (**Figure 4**). Using higher P rates did not result in a reduction in net return compared to applying no P. These numbers do not account for any residual P available for the following crop.

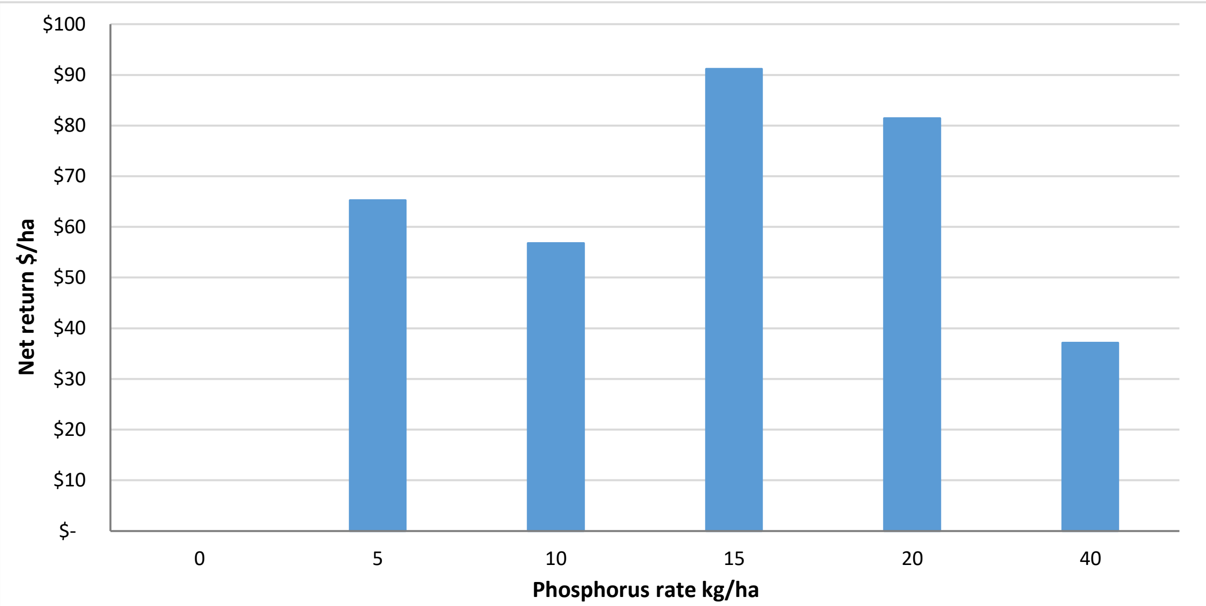

Figure 4. Net return ($/ha) from increased P rates (kg/ha) at sowing compared to zero P.

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[4] Rainfall data from the Wilmatha Station (50108), SILO – Australian Climate Data.

Conclusion

Application of no P in a very dry season can severely limit yields (where background P is low).

In a site with low background P levels, a rate of 15kg/ha was required to maximise both yields and net returns.

Lower rates of P, 5 and 10 kg/ha did reduce yields and net returns

If a paddock has a history of P responsiveness or soil tests are considered low, then reducing the amount of P applied may limit yield potential.

Conduct periodic soil testing and use test strips to better understand paddock P responsiveness.

Acknowledgements

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DISCLAIMER — TECHNICAL

Appendix

Table 3. Site results

P rate (kg/ha)	NDVI		Protein (%)		Screenings (%)		Yield (t/ha)	
0	0.18	d	19.5	ab	8.5	cd	0.09	c
5	0.20	c	19.4	ab	8.0	d	0.28	b
10	0.21	c	19.8	a	8.9	bc	0.29	b
15	0.22	b	19.3	b	9.5	b	0.40	a
20	0.22	a	19.3	b	9.1	bc	0.41	a
40	0.22	a	19.4	ab	10.3	a	0.44	a
LSD	0.01		0.4		0.7		0.05	