GOA Trial Site Report

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

Trial code:	GONU02118-4
Year:	Winter, 2018
Location:	'The Plains', Nyngan
Trial partners:	Haydon Wass

Keywords

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

Key findings

- Application of no P in a very dry season can severely limit yields (where background P is low).
- In a long fallow situation, with low background P levels, a rate of 20kg/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.

Background

The 2018 year was one of the driest seasons on record in Central West 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. It is also well known that P is not used in one year 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.

Conventional wisdom[1] would suggest 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 accumulation in the order of 5 kg P/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).

[1] GRDC Wheat Grownotes – Northern Region

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 being assessed as having reasonable P levels prior to trial (as subsoil P was not tested, only tested the 0-10 cm layer). In contrast research in Western NSW[3] from 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.
- Six P 6 rates: 0, 5, 10, 15, 20 and 40 kg/ha as triphos.

Results were analysed by ANOVA and results compared by using LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed to be statistically different, unless otherwise stated. The Analysis of Variance (ANOVA) and Least Significant Difference (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(1)	**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 Chromosol (ASC)
Previous crop	Long fallow (2017) Wheat (2016)	**Pre-sowing stubble management**	Direct drilled
Soil nutrition at sowing	Colwell P 22 ppm, Sulphur 7 ppm	**Nitrogen**	0-10cm ~ 48 kg/ha, 10-90cm ~ 69 kg/ha

[2] https://www.farmtrials.com.au/trial/13734

[3] http://www.publish.csiro.au/an/EA97104

Table 2: Nyngan rainfall in 2018 and the long-term average (LTA)

The Plains, Nyngan rainfall													
Month	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**TOTAL**
2018	61	12	2	6	11	34	1	14	8	65	55	18	**287**
LTA	63	52	44	37	39	33	32	27	29	37	39	39	**471**

Results

The full results are listed in the attached annex.

Vegetation index (VI)

- The VI increased by 29% by adding 15 kg/ha P (**Figure 1**), compared to the nil P treatment.
- Adding a further 25 kg/ha (i.e., 40 kg/ha of P) did not increase the VI.

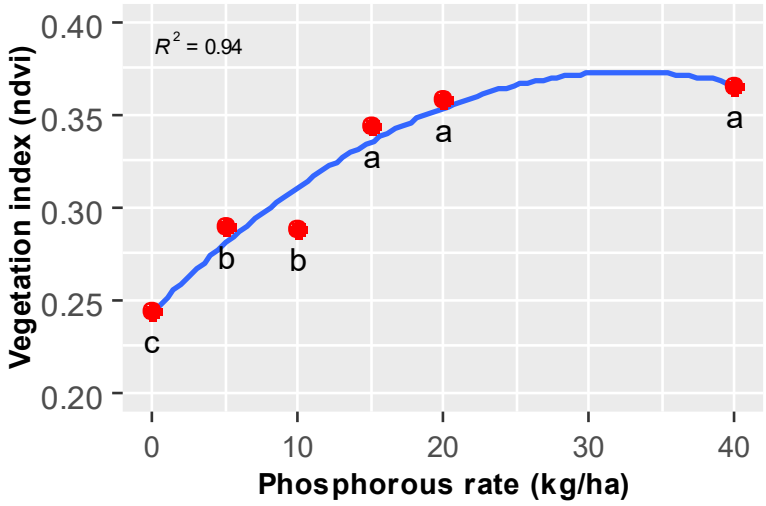

Figure 1. Vegetation Index (NDVI) in response to increasing rates of P fertiliser (kg/ha). Assessed 56 days after sowing. Treatments with the same letter are not significantly different.

Yield

- The highest yield (2t/ha) was at the highest P rate (**Figure 2**).
- Where no P was applied, the yield was limited to <1.4 t/ha.
- Adding 5, 10 or 15 kg/ha P did not significantly increase yield compared to no P.
- The addition of 20 kg/ha increased yield to 1.8 t/ha.

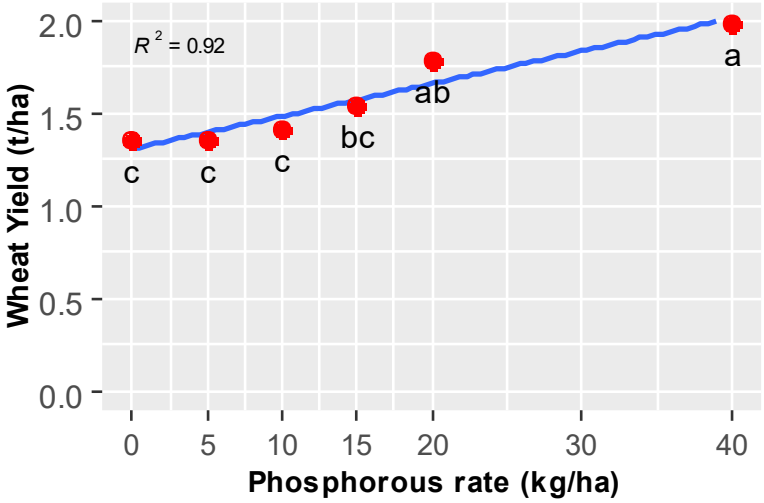

Figure 2. Wheat yields in response to increasing rates of P fertiliser. Treatments with the same letter are not significantly different.

Protein

- Protein was very high, with all treatments being above 17%.
- Protein levels decreased with increasing P rates.
- Where no P was applied, grain protein was 18.5% and decreased to 17.4%, where the crop was supplied with 40 kg/ha P.

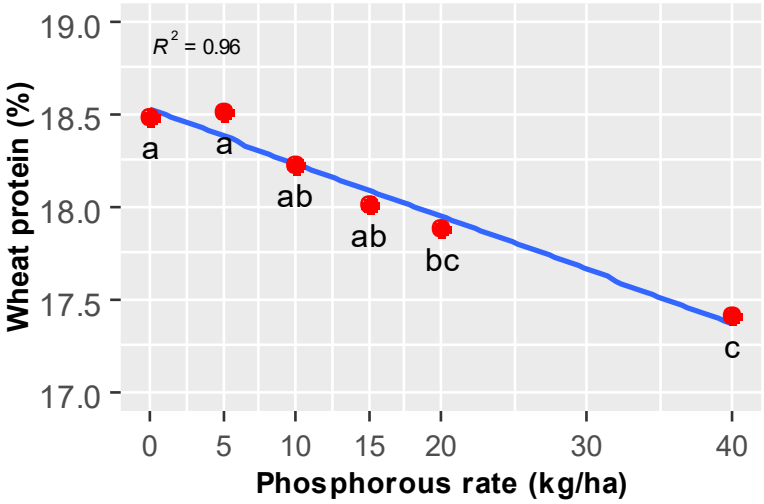

Figure 3. Wheat protein (%) in response to increasing rates of P fertiliser (kg/ha). Treatments with the same letter are not significantly different.

Screenings

- Screenings in all treatments were <5% (**Figure 4**).
- Where 40 kg/ha of P was applied the screenings were approximately 70% higher than where no P was applied.

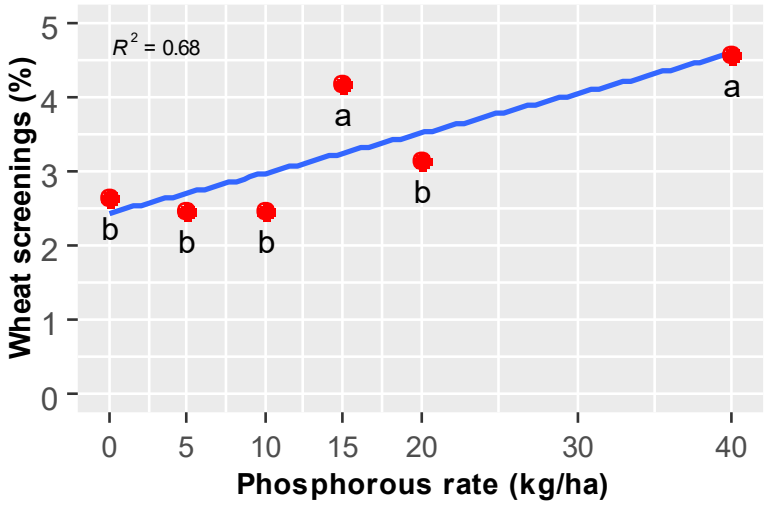

Figure 4. Wheat screenings (%) in response to increasing rates of P fertiliser (kg/ha). Treatments with the same letter are not significantly different.

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 variety Spitfire().

Rainfall was also well below average in both 2017 and 2018 **(Table 2)**. However, this paddock was long fallowed and during this period there was approximately 520 mm or rainfall. In-crop rainfall was approximately 140 mm. The annual rainfall for 2017 and 2018 respectfully was 393 and 287 mm, well short of the 471 mm average[4].

Starting P levels in this paddock (22 ppm in the top 10cm) were low and at a level where P responses could be expected. The grower indicated that he generally applies around 70-75 kg/ha MAP (~15-16 kg/ha P) annually.

In this trial, reducing P rates from 20 to 10 kg/ha resulted in a 21% reduction in yield, while the zero P treatment resulted in >24% yield reduction. Increasing P rates from 20 to 40 kg/ha did not further improve yields.

Protein levels were high, and in all cases would have made a premium, hard wheat grade. Protein declined with increasing rates of P, inverse to the yield response. It is likely this decline is due, in part, to yield dilution. Screenings increased with increasing P rate but were not high enough with any P treatment to incur a grain grade penalty.

The VI assessment taken less than 2 months after sowing, showed an early trend in crop growth that was reflected in yields. This highlights the importance of P for early crop growth, and its influence on final crop yields.

The 2018 season was a very dry, with the long fallow practiced over the previous year enabling a modest yield.

Using a simple economic analysis comparing yield increases and accounting for fertiliser costs and grain quality, showed that reducing P rates would not have enabled the full return from the long

[4] Rainfall data from NYNGAN 'The Plains' Station (ID 51118), SILO – Australian Climate Data.

fallow. If the P rate was reduced from 20 to 10 kg/ha, there would have been a ~$140/ha worse off net return (**Figure 5**). 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.

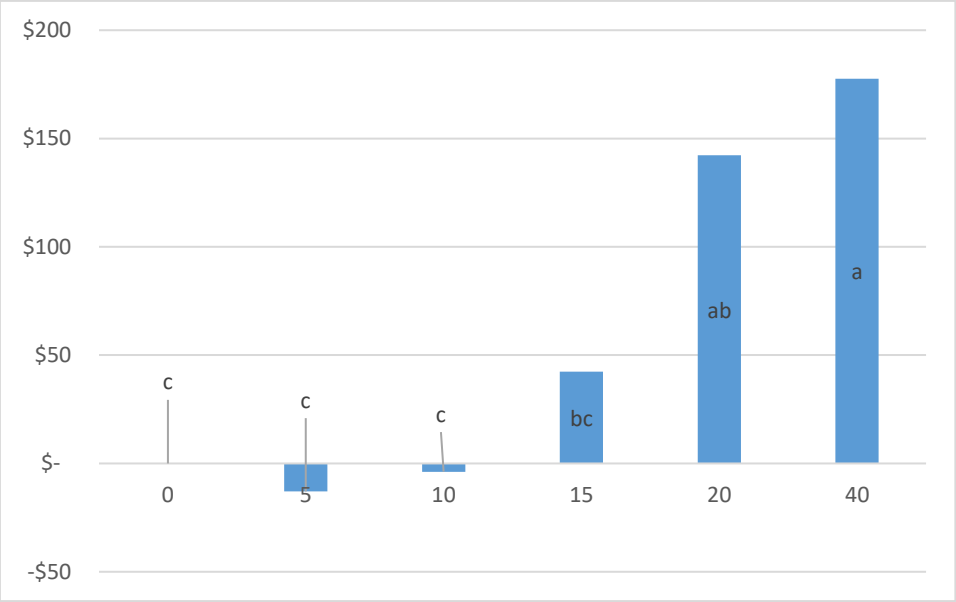

Figure 5. Net return ($/ha) from investment in phosphorous fertiliser (kg P/ha) compared to applying 0 P.

Conclusion

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

In a long fallow situation site with low background P levels, a rate of 20kg/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 paddock has a history of P responsiveness or soil tests are low then reducing P may limit yield potential.

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

Acknowledgements

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Appendix

Table 3. Site results

P Rate	Protein		Screenings		Yield		NDVI	
	%		%		t/ha			
0	18.5	a	2.6	b	1.4	c	0.37	a
5	18.5	a	2.5	b	1.4	c	0.36	a
10	18.2	ab	2.4	b	1.4	c	0.34	a
15	18.0	ab	4.2	a	1.5	bc	0.29	b
20	17.9	bc	3.1	b	1.8	ab	0.29	b
40	17.4	c	4.6	a	2.0	a	0.24	c
lsd	0.6		1.0		0.3		0.03	