GOA Trial Site Report

Wheat: revisiting phosphorous management. Wongarbon 2021.

Grain Orana Alliance

2023-04-13

Trial code:	GANU02821
Season/year:	Winter 2021
Location:	"Carawatha", Wongarbon
Trial partners:	Al and Gus Kelly
Trial establishment date:	14/5/2021

Keywords

GANU028, phosphorous, nutrition, Colwell P, drought, crop failure, carry over, residual nutrition, stratification.

Key Findings

- There was a large yield response to P.
- Appling P to the soil surface prior to sowing or post sowing did not result in yield reductions compared to placement with the seed.
- Where 10 kg P/ha was applied, there was no yield difference between the placement treatments.
- The highest yields were achieved where a total of 40 kg P/ha was applied.

Background

Phosphorous (P) management in wheat is well understood and management is relatively simple with the standard practice of applying P at sowing with the seed.

Recent increases in P prices and its reduced availability have given farmers cause to look seriously at their fertiliser budgets. Growers with canola in their rotations and disc seeding systems are looking at ways to get P into the system, while avoiding known issues of fertilizer burn affecting canola establishment. This is sometimes done by 'loading' P in the previous cereal crop, where excess rates of P are applied with the theory that some P will be remaining for the next canola crop.

Despite the limited movement of P in the soil, several trials conducted on canola has shown that P applied through topdressing can be just as efficient as other P placement methods (with or below the seed or incorporated by

sowing (IBS)). This could indicate that canola is not as reliant as wheat on P in the initial stages of growth. The environmental conditions created by the canola canopy (i.e. damp soil surface) can also be conducive to P accessibility. Some canola growers are now successfully using these experimental findings to spread a portion of their P budget pre-sowing.

Having the ability to pre-spread a portion of the P budget in the fallow prior to sowing wheat would have considerable machinery and labour unit efficiencies (that may be underutilised in the pre-sowing fallow). Having the ability to delay P application may be useful if P is expensive or in short supply. A purchase delay (some or all budgeted amount) may allow for fine tuning to better match the seasonal outlook.

Topdressing P either before or after sowing is not recommended by NSW DPI stating that it is less effective, and that 'at least' double rates may be required[1]. However older research conducted in the USA found that topdressing P up to 2 months post sowing did not result in any yield reductions compared to standard applications at sowing[2]. Previous trials conducted by Grain Orana Alliance (GOA) showed canola to responded well to topdressed P[3], but wheat may not respond as well due to its more open canopy, which is less conducive to maintaining a wet soil surface where roots can proliferate. This trial is designed to see if there is any yield or grain quality response to surface or delayed applications of P in wheat.

Aims

Determine the yield and grain quality response of wheat to alternative placement, or delayed applications of P compared to the standard practice of application with the seed.

Methodology

Site Selection: This site was selected because it was very low in soil P. Testing of soil from this site (Table 1) showed that the topsoil had critically low levels of Colwell P and was below detection levels deeper in the profile.

Table 1: Soil P.

Location	Analyte / assay	Unit	0-10 cm	10-30 cm	30-60 cm	60-90 cm
Wongarbon	Phosphorus (Colwell)	mg/kg	14	<5	-	-

Table 1: Wongarbon rainfall versus the long-term average (LTA).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2021	51	68	136	8	29	104	74	34	41	55	159	42	901
LTA	55	51	65	41	38	51	46	42	48	51	70	65	623

[1] Phosphorus nutrition for winter crops (nsw.gov.au)

[2] BC-1993-3 p27.pdf (ipni.net)

[3] Documents - Grain Orana Alliance

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Treatments

Randomized split plot; small plot (~12 m x 2 m) with 3 replicates.

P rates

- Applied at 4 rates: 0, 10, 20, and 40 kg/ha.
- Applied as MAP, nitrogen (N) component of MAP balanced with urea.

P placement

- IBS: treatments spread ahead of sowing.
- With seed: farmers standard district practice.
- Split 5P with seed: balance applied IBS.
- Split 10P with seed: balance applied IBS.
- Topdressed @ sowing: applied post-sowing on same day.
- Topdressed @ 4 weeks: applied one month after sowing (16/06/2021).
- Untreated control (UTC): no applied P (N balanced with urea).

Results

The wheat crop in 2021 was good, the average site yield was 5.8 t/ha (Figure 1) with average protein levels at 11% (Figure 2). The complete set of results are in the Annex **(Table Table *2*)**.

Yield

- There was a large yield response to P, with ~1.8 t/ha difference between the highest yielding treatments and the UTC.
- Where 10 kg P/ha was applied, there was no yield difference between the placement treatments.
- Where 20 kg P/ha was applied, the district practice of placing the fertiliser with the seed had the highest yields but was not significantly different to topdressing at sowing or either of the split treatments. It was however better than the IBS and the topdressing at 4 weeks.
- The highest yields were achieved where a total of 40 kg P/ha was applied with no difference between the placement treatments.

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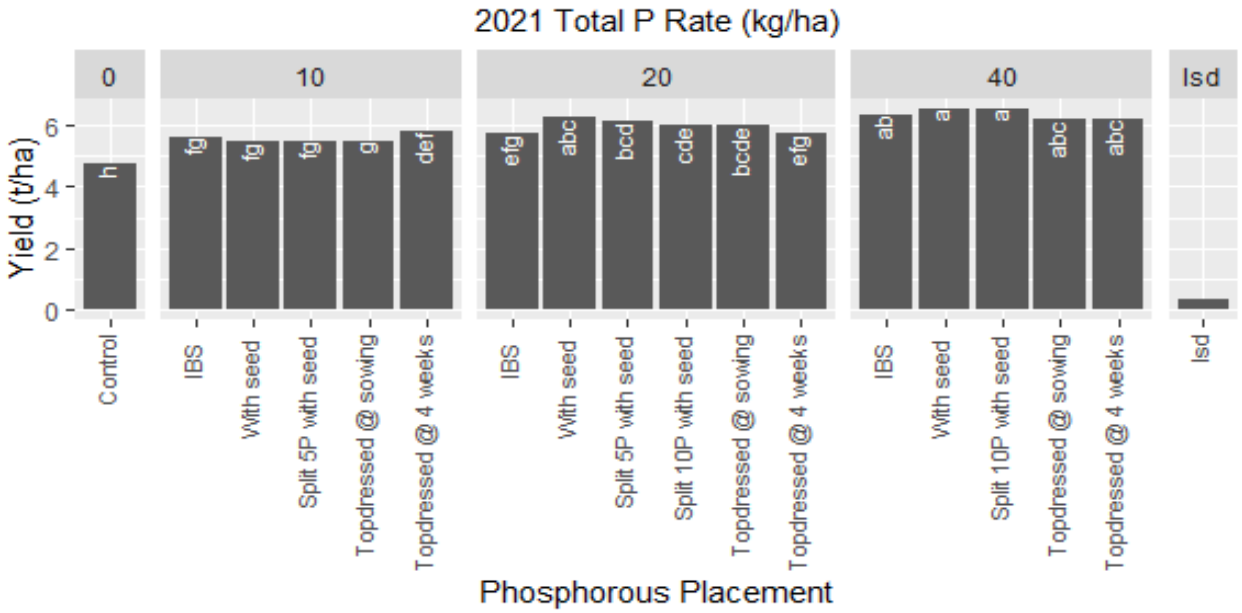

Figure 1. Wheat yield by total P rate and placement. Treatments with the same letter are not statistically different.

Protein:

Protein levels tended to decline as P rate increased. Treatments with higher yields had mostly lower protein levels (*Figure 2).*

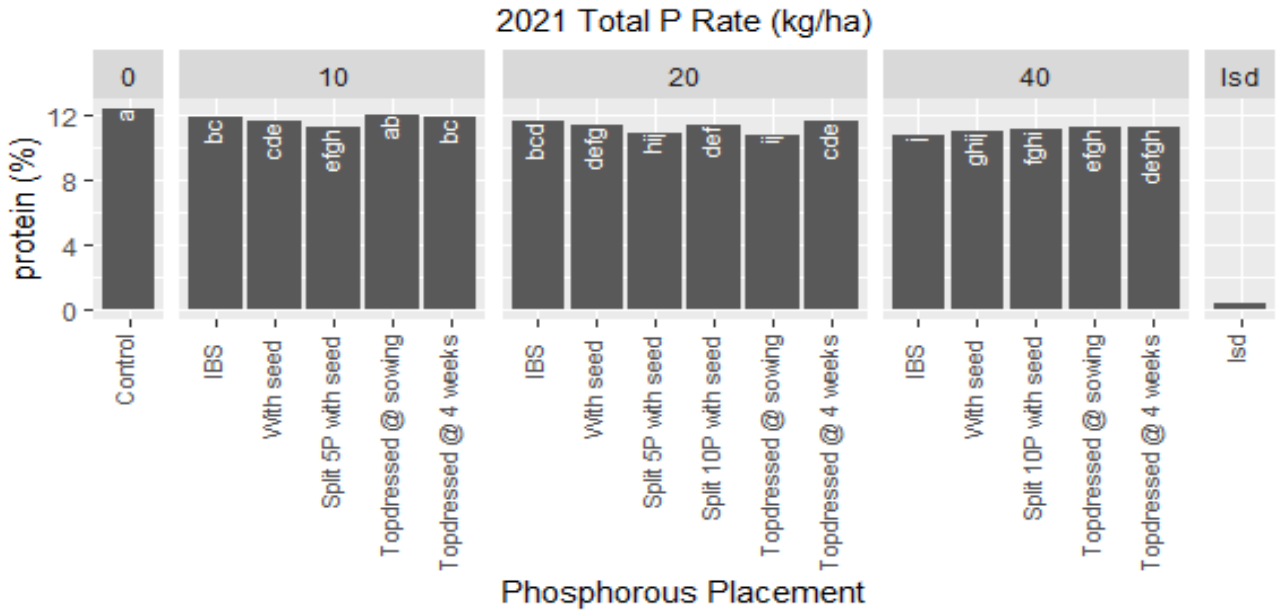

Figure 2. Wheat protein by total P rate and placement. Treatments with the same letter are not significantly different.

Discussion

The 2021 year was very wet with 901 mm received comparted to the LTA of 623 mm **(Table 2)**. The in-crop rainfall at this site was ~533 mm, with over 180 mm falling in the first 2 months post-sowing.

There was a very large response to added P, with the highest yields at the highest rate, however there were no differences in the different placement options tested. As 2021 was a very wet year, particularly post sowing, it is likely that having a wet soil allowed shallow root proliferation that were able to access to surface applied P. This might not be the case in a drier year.

The results of the IBS treatments would suggest that there is an option to spread P in the fallow prior to sowing, allowing for more efficient use of machinery and labour units at less busy times of the year, and improve sowing efficiencies.

Splitting the applications is an option that might minimise the risk of applying all the fertiliser P in the fallow. Under marginal conditions access to surface applied P might be limited however the crop is likely to have a lower yield potential and hence a lower P requirement. Managing the split application to ensure that there is sufficient P to satisfy the crop requirements under marginal conditions with the surface applied P allowing the crop to capture higher yields under optimal conditions. Using the split application to apply some of the P in the fallow and the rest at sowing may not spread the financial risk as much as splitting the P between sowing and a later topdressing where there is time to adjust application to emerging seasonal condition.

Conclusions

- Wheat can be very responsive to applied P in deficient soil, and rate had more influence on yields than placement.
- In a very wet year, such as 2021, wheat was able to access P when it is applied to the soil surface (not incorporated), either at or post sowing.
- Applications before sowing (in the fallow) may optimise machinery and labour units without compromising yields.
- The option to topdress may give farmers greater time to make more accurate yield assessments, enabling the matching of fertiliser requirements to the predicted yield.
- Split applications may reduce the risk of fallow applications without compromising yields.
- These results challenge some of the paradigms of P management in wheat, and further testing of P management is warranted, particularly split (sowing-topdressing) applications.
- Applying higher rates of P fertiliser may overcome shortcomings in placement.

Acknowledgements

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Appendix

Table 2. Trial results 2021

Phosphorous									
Placement	**Rate**	**Yield**		**Test weight**		**Protein**		**Screenings**	
	(kg/ha)	**(t/ha)**		**(kg/hl)**		**(%)**		**(%)**	
Control	0	4.7	h	73.8	a	12.4	a	3.4	a
IBS	10	5.6	fg	72.7	bc	11.9	bc	3.3	ab
	20	5.8	efg	72.5	bcd	11.6	bcd	3.3	abc
	40	6.4	ab	71.6	fg	10.7	j	2.8	de
With seed	10	5.5	fg	72.3	bcde	11.6	cde	2.8	cde
	20	6.3	abc	72.0	defg	11.4	defg	2.6	e
	40	6.5	a	71.8	efg	11.0	ghij	3.0	bcde
Split 5P with seed	10	5.5	fg	72.5	bcd	11.2	efgh	3.1	abcd
	20	6.1	bcd	72.3	bcde	10.9	hij	2.9	cde
Split 10P with seed	20	6.0	cde	72.2	cdef	11.4	def	2.9	bcde
	40	6.6	a	71.8	efg	11.2	fghi	2.7	de
Topdressed @ sowing	10	5.5	g	72.8	b	12.0	ab	3.3	abc
	20	6.0	bcde	72.1	def	10.8	ij	2.7	de
	40	6.2	abc	71.8	efg	11.2	efgh	2.8	de
Topdressed @ 4 weeks	10	5.8	def	72.7	bc	11.9	bc	2.8	de
	20	5.8	efg	72.2	bcde	11.6	cde	2.8	de
	40	6.2	abc	71.5	g	11.3	defgh	3.0	bcde
lsd	lsd	0.3		0.6		0.4		0.5	