

## Phosphorus carryover after a crop failure and the implications for phosphorus PLACEMENT in the following wheat crop.

Grain Orana Alliance

2022-12-12

<b>Trial code:</b>	GONU02320-1
<b>Season/year:</b>	Autumn 2019-20
<b>Location:</b>	Gordon Park, Trangie
<b>Trial partners:</b>	Andrew Freeth
<b>Trial establishment date:</b>	2/10/2019

### Keywords

GONU023, phosphorous, nutrition, Colwell P, drought, crop failure, carry over, residual nutrition, stratification, Trangie

### Key findings

- Phosphorous (P) applied during a drought was still available for the subsequent crop.
- The highest yields were obtained where 10 kg P/ha was applied in 2019 and a further 10 kg/P in 2020.
- The 2020 crops' ability to access residual P was not influenced by sowing over or between the previous year's fertilizer rows in 2020, a relatively wet season.

### Background

During the 2017-19 drought, many farmers faced reduced incomes and sought ways to reduce costs. With this parameter can P rates be reduced, particularly where P has been applied in a previous failed crop. The location and availability of the P in the soil profile needs to be considered, specifically where it is banded and in controlled traffic systems.

P is relatively immobile in the soil and its placement in a failed crop situation and the positioning of the seed in the following year could influence its availability.

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There has been some research into P placement in cereals, suggesting placement is more important in dry than wet seasons. However, there is no research into P placement following a crop failure, or how this might influence the P rate applied in the following season. If the P has been banded with the seed, sowing over the previous year's rows might displace the P in a tyned sowing situation, while sowing between the rows might limit access to the P in dry seasons, particularly if it's a dry start.

The primary aim of this trial is to investigate interactions between seed placement and P uptake following the previous year's crop failure. The secondary consideration will be looking at the availability of P from one season to the next.

## Aims

To investigate if there is a yield response to seed placement in year 2 when placing the seed on top on the previous year's band of P fertiliser in a failed crop scenario in a knife point press wheel system in wheat.

## Methodology

Trial design		
Type	Small plot (~12m x 2 m)	
Design	Randomized split plot	
Replications	5	
Analysis	ASREML	
Confidence interval	95%	

### Site Selection:

This site was selected as it should have been P responsive. Soil testing (Table 1) showed the topsoil with critically low levels of Colwell P and levels below detection deeper in the profile.

**Table 1:** Soil P

Location	Assay	Unit	0-10 cm	10-30 cm	30-60 cm	60-90 cm
Gin Gin	Phosphorus (Colwell)	mg/kg	21	5	<5	<5
Gin Gin	Phosphorus (BSES)	mg/kg	24	<5	<5	<5
Gin Gin	Phosphorus Buffer Index		67	62	100	140

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**Table 2:** Trangie rainfall, 2019 and 2020 and long term average (LTA).

Trangie rainfall													
Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
2019	58	17	18	0	19	6	10	3	5	2	20	2	<b>160</b>
2020	5	96	113	118	18	16	68	38	40	29	12	77	<b>630</b>
LTA	52	51	49	41	36	37	34	32	31	45	45	42	<b>495</b>

## Treatments

### Drought year: Year 1 (Y1)

P applied on 2/10/2019:

- two P rates 0 and 10 kg/ha.
- crop not sown due to low rainfall (Table 2) and P drilled in October using plot seeder.
- Phosphorus applied as MAP
- nitrogen (N) portion of MAP balanced with urea so amount of N uniform across all plots.

### Subsequent year: Year (Y2)

P applied at sowing in 2020:

- two P rates: 0 and 10 kg/ha.
- two positions, on row and mid row (relative to the previous year's fertiliser application).
- phosphorus applied as MAP
- nitrogen (N) portion of MAP balanced with urea so amount of N uniform across all plots.

## Results

The average site yield was 5.7 t/ha and the average protein was 14%.

### Yield:

There was a yield response to phosphorous. Adding 10 kg P/ha in 2019 increased yield by aver 100 kg/ha compared to the control. Adding 10 kg/ha P in 2020 increased yields by over 500 kg compared to the control, as did adding 10 kg/ha in both years. There was no difference between yields if the subsequent crop was sown either over or between the previous year's sowing rows (Figure 1).

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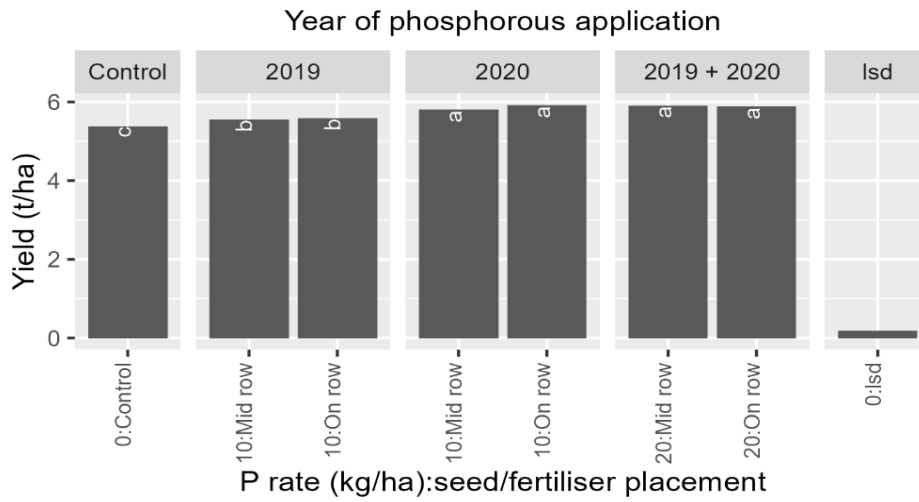


Figure 1: 2020 Wheat yield by P rate applied in 2019, 2020 and placement location (in relation to where seed was sown in 2020). Treatments with the same letter are not significantly different.

## Protein:

Adding P in both 2019 and 2020 resulted in the highest protein levels, above 14.5%. Sowing over the same row increased protein levels where only 10 kg P/ha was applied in 2019 compared to sowing in the mid row (away from the fertiliser). There was no difference where 20 kgP/ha was applied (10 kg in each year) (Figure 2).

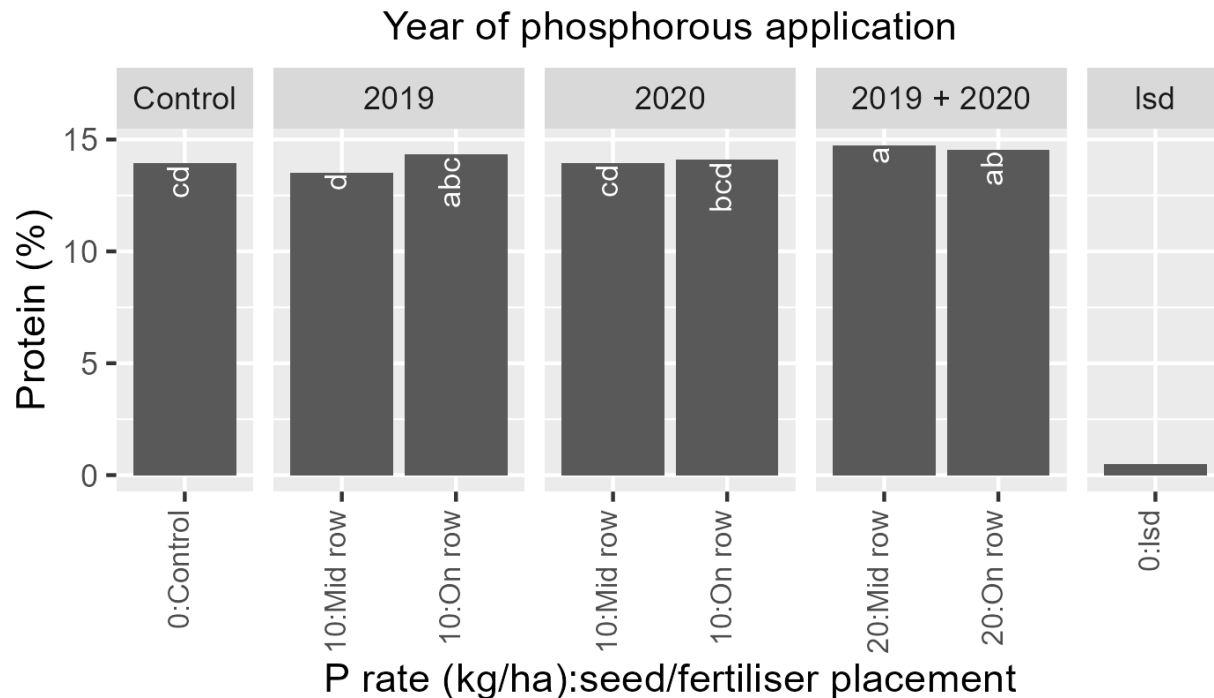


Figure 2: Wheat protein (%) in 2020 by P rate in 2019, 2020 and placement. Treatments with the same letter are not significantly different.

### Screenings:

There were no differences in screenings between treatments.

### Discussion

Wheat yields in 2020 were high, between 5.3 and 6.0 t/ha. This would equate to a P removal in grain of between 15 – 18 kg/ha.

This site had very low background levels of P, with Colwell P of 21 ppm in the 0-10 cm soil layer. Not surprisingly the site was P responsive with >600 kg/ha difference between the best yielding treatment and the untreated.

There was no yield response to placement. This indicates that wheat does not necessarily need starter fertiliser to be placed with the seed, as the plant can access fertiliser banded in the mid row (from the previous year). The placement of P in the year of crop failure is likely to be of even less importance if even a low rate of P is placed with the seed in the subsequent year (see GOA reports on P rates following drought). Keep in mind that 2020 was a wet season, and the outcomes may be different in dry conditions.

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There was an increase in both protein and screenings where 10 kg P/ha was placed away from the seed in the drought year. This outcome is difficult to explain and requires further investigation. It may possibly be related to a modest early P deficiency (positional stratification), which subsequently delays tillering and canopy closure, which can reduce N uptake efficiency and remobilization—key drivers of grain protein, particularly in a season wasn't necessarily moisture limited at grain fill.

## Conclusions

- Wheat's ability access residual P was influenced by sowing between the previous year's fertilizer rows in 2020 (a relatively wet season) and had a negative effect on protein and screenings where modest rates of starter fertiliser were used
- This effect was eliminated by adding 'topping up' in Y2 (or sowing over the previous year's rows).
- Phosphorous applied during a drought was still available for the subsequent crop.
- Topping up P in the subsequent crop improved yields (in low P situations).

## Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the Grains Research and Development Corporation (GRDC). The authors would like to thank them for their continued support. Special thanks to Andrew Freeth who hosted this trial.

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## Appendix

### Results

Table 2: Trial results 2020

Phosphorous rates										
2019	2020	Seed Placement	Yield		Test weight		Protein		Screenings	
(kg/ha)			(t/ha)	(kg/hl)	(%)		(%)			
0	0	Control	5.4	c	73.8	a	13.9	cd	7.6	a
	10	Mid row	5.8	a	74.0	a	14.0	cd	6.5	ab
		On row	5.9	a	74.7	a	14.1	bcd	5.9	b
10	0	Mid row	5.6	b	74.4	a	13.5	d	6.2	b
		On row	5.6	b	74.7	a	14.3	abc	7.1	ab
	10	Mid row	5.9	a	74.4	a	14.7	a	6.4	b
		On row	5.9	a	74.3	a	14.5	ab	7.0	ab
lsd	lsd	lsd	0.2		1.2		0.5		1.3	