GOA Trial Site Report

Phosphorous placement and its effect on establishment and performance of canola

Trail Code: GONU00617-5

Season/year: Winter 2017

Location: Geurie

Collaborators: Brett Robinson

Keywords

GONU006, phosphorus, deep banding, IBS, canola, germination, establishment, P rate, Geurie

Take home messages

Canola generally shows a good yield response to added P fertiliser in soils testing low in phosphorus (P).

While not reflected in this trial, placement of P with canola seed can adversely impact germination level, even at lower P rates. Where possible growers should consider alternative P placement or compensate by adjusting seeding rate.

In dry seasons, placement of P below the seed is likely to be a better strategy than P placement with the seed.

Surface applied P, in this experiment provided a useful, although small, yield increase. Given a yield increase in such a dry year, the research suggests further studies are warranted into the usefulness of broadcasting P ahead of Canola sowing.

Background

Phosphorus (P) is an important nutrient in canola production at two key stages; establishment to support root development and during biomass accumulation.

Traditionally, P has mainly been applied at planting and often is banded in close proximity to seed. This approach is based on P being relatively immobile in the soil and needs to be placed close to the developing canola root system.

Damage to crop establishment by placing fertiliser P close to seed has long been accepted. For example, trials conducted in 2013 by NSW Department of Primary Industries[1] found significant reductions in canola establishment with increasing rates of P (up to 20 kg/ha). Yields also increased with increasing P rates despite emergence suppression. A consequence of establishment suppression is the unpredictability and variability of damage, which can make targeting an ideal seeding rate difficult. If effect on establishment is high, very poor stands can eventuate and they may be unable to adequately compensate for low plant numbers. Yield may be adversely affected. Nonetheless, increasing seeding rate can compensate for these losses, though this comes at a cost.

[1] https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/Canola-agronomy-research-in-central-west-NSW

The dilemma, therefore, is that canola crops mainly require fertiliser P for optimise yields, however, placing P with seed can lead to significant problems. NSW DPI trials referenced above did not investigate alternate placement options for applying P to canola.

Many modern seeders have the ability to band fertiliser below the seed. There is also the option with any sowing equipment to broadcast P either pre or post seeding. This trial is designed to investigate if application of P using alternate methods could avoid damage at establishment while maintaining a positive P fertiliser response.

Aims

Determine if varying P placement and the rate of P fertiliser can reduce negative impacts on crop establishment and yield, while maintaining canola P responsiveness.

Methods

The trial was a small plot, full factorial randomised complete block design with three replicates established in autumn 2017.

The rate of P applied and the effect of P placement on canola germination and yield is to be assessed. All combinations of P rate and seed placement were addressed in the trial design.

- **Rates:** Three rates of P in the form of triple superphosphate (Trifos) were applied at 0, 15, 30 and 45 kg/ha of P
- **Placement:** The P fertiliser was applied by three methods-
  - Below the seed - in a band approximately 6 cm below the soil surface and 4 cm directly below the seed, applied in the same pass
  - With the seed - banded with the seed in the same pass
  - Incorporated by sowing (IBS) Broadcast onto the soil surface prior to seeding and incorporated by the seeder
  - Broadcast - on the soil surface post planting with no incorporation

Table 1. Trial site details

Trial Establishment Date	Autumn 2017	**Seeding rate**	2.5 kg/ha
Crop and Variety	Canola – GEM	**Harvest Date**	23/11/2017
Sowing date	2/5/2017	**Row Spacing**	27.5 cm
Seedling equipment	Double Boot Tyne	**Soil type**	Sandy Clay Loam
Nitrogen Crop Nutrition Urea (kg/ha)	200 IBS	**Previous Crop**	Wheat
Site Nutrition: Colwell P	0-10 cm: <5 ppm 10-60 cm: 9 ppm	**Pre-Sowing Stubble Management**	Standing stubble

Results were analysed using ANOVA for the analysis of variance and results compared by using a 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.

Results

Table with full results are listed in Appendix 1.

Plant Establishment: Average plant population was 17 plants/m^2. Placement of P with seed did not significantly reduce plant establishment. Neither was there a significant impact of phosphorus rate on plant establishment for all placement treatments. While not statistically significantly the lowest population (13 plants/m^2) was where 45 kg/ha P was placed with seed at planting.

Yields: Treatments where P was applied yielded 0.4-0.6 t/ha greater than nil P treatment. Yield response tended to increase with amount of P applied up to 30 kg P/ha (**Figure 1**).

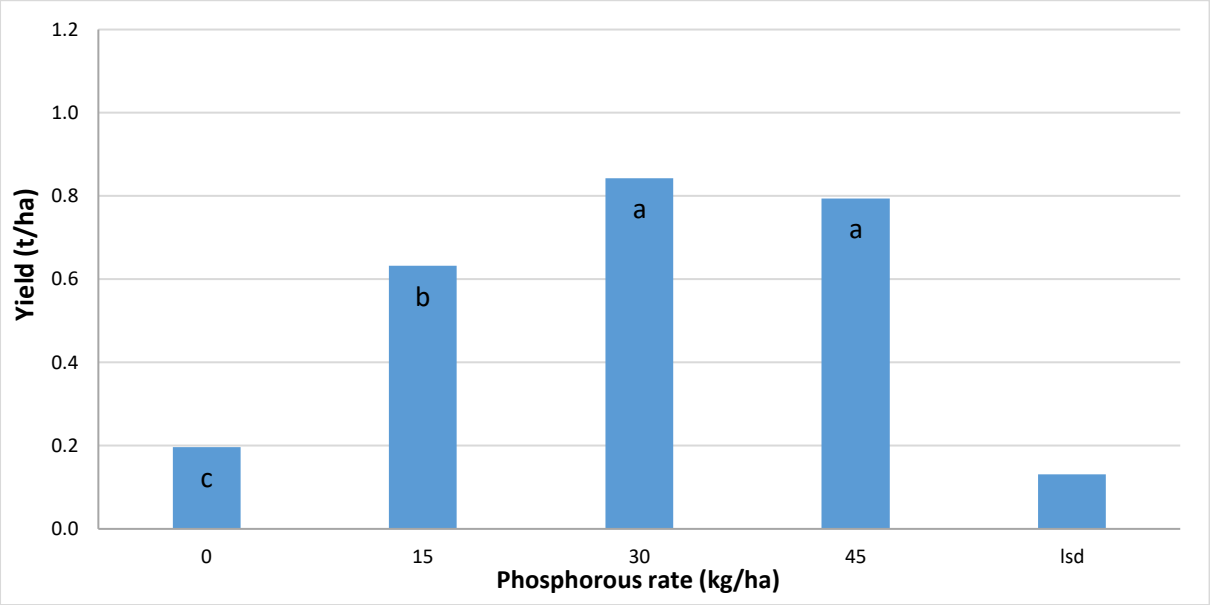

Figure 1. Yields (t/ha) for the four phosphorous application rates.

There was a yield advantage of 0.9 and 0.7 t/ha by placing P below and with the seed respectively at sowing compared to nil P (**Figure 2**). Where P was applied to the soil surface, either IBS or spread post sowing, yield response was modest in comparison to below or with the seed. Response was around 0.3 t/ha.

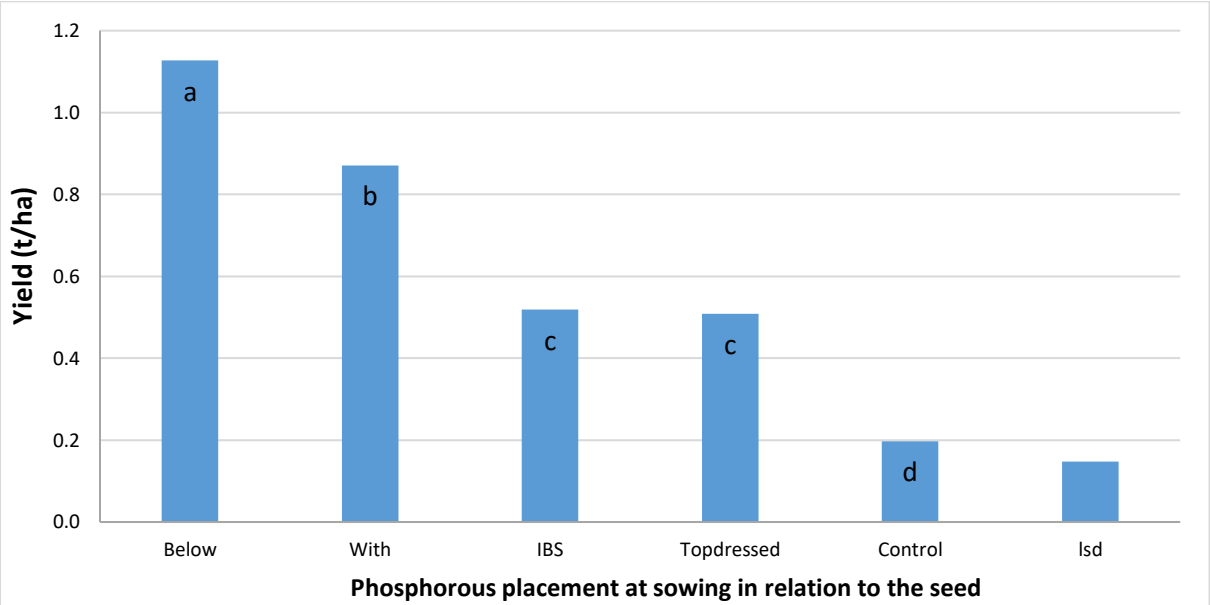

Figure 2. Yields (t/ha) for the four placement options. 'Below' and 'With' the seed, top-dressed pre sowing (IBS) and top-dressed post sowing. Control is nil applied P.

There was no interaction between P rate and P placement. However, when the two surface applied treatments (IBS and Broadcast post sowing) were compared to the subsurface banded treatments (with and below seed), a clearer pattern emerged. Plants were better able to exploit higher P rates where P was banded compared to surface P treatments (**Figure 3**).

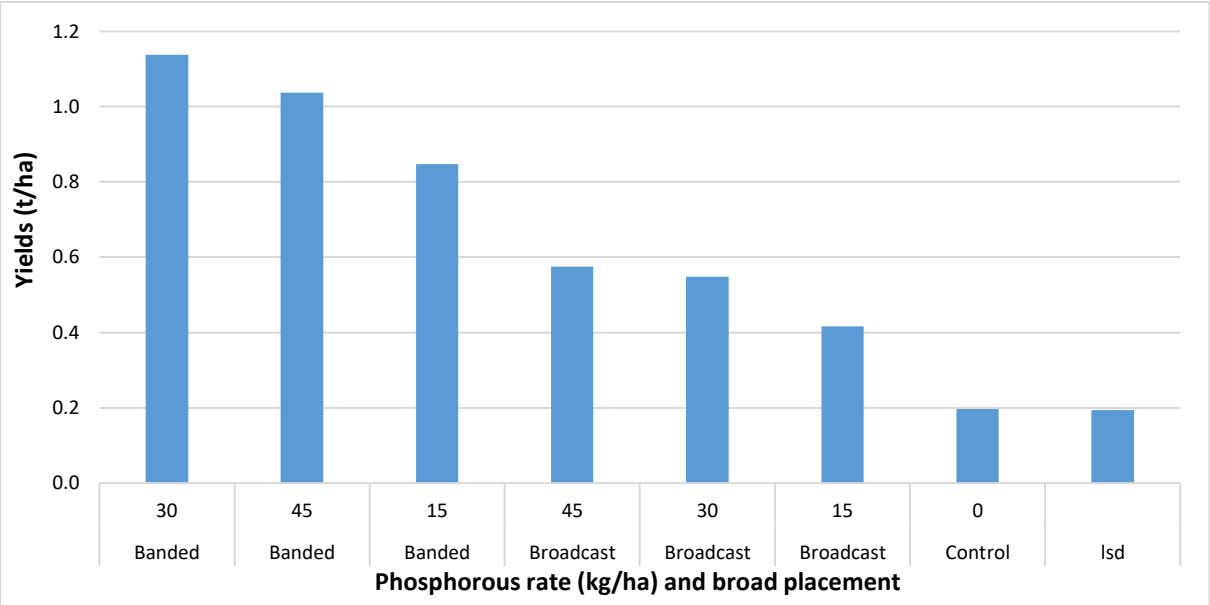

Figure 3. Yields (t/ha) for banded P placement (average below and with seed) compared to broadcast on the soil surface (average IBS and post sowing), at 4 P rates. Control is where no Phosphorous was applied.

Oil %: There was no influence of P rate or placement on oil percentage.

Discussion

This site had very low initial P levels, with Colwell P of less than 5 ppm in the surface 10 cm layer and ~ 9 ppm in the 10 – 60 cm soil layer. These low levels of background P resulted in a significant yield response to both P rate and placement.

2017 was a very dry season, particularly at the start (~47 mm in the 60 days post sowing). The ~40-60% lower yield response of the surface applied P compared to the sub-surface applied treatments may be explained by insufficient rainfall to either allow adequate incorporation of the surface applied P fertiliser or for the plants to develop sufficient root systems to explore surface applied P. Despite the poor performance from surface applied P, it is noteworthy that there was a significant if smaller response to surface applied P compared to nil applied P.

Placement of P with seed is a main method of application for many farmers in the GOA region, and in this trial it was a far better option than applying P to the surface. No differences in crop establishment were measured, which maybe reflective of the relatively dry sowing conditions.

Placement of P below the seed was by far the best performing placement treatment. It is likely that deeper placement of P (4-6 cm below the seed) where there is moisture for a longer period during early plant development, therefore allowing longer access to fertiliser applied P. An avenue for further research would be to see if an even deeper application would add to even further yield gains. It is also

plausible that applying P in a way such that it is evenly distributed in the surface 5-10 cm may give further yield improvements (as opposed to being banded or placed on the soil surface).

At this site (and in this season) the optimal P rate for maximising production was between 15 and 45 kg/ha, however, this may not necessarily reflect an optimal economic return.

Conclusion

In soils with low starting P, canola is likely to show a more than significant yield response to added P fertiliser.

While not necessarily reflected in this trial, placement of P with seed can impact germination, even at lower rates. Where possible growers should consider alternative placement or compensate by adjusting the seeding rate.

In dry seasonal conditions, placement of P below the seed is likely to bring the most benefit, followed by placement with the seed (though take note of comment above).

Given that there was a yield response, albeit small, to surface applied P, even in very dry conditions, the option to broadcast P ahead of sowing warrants more testing, including the option of split with applying with or below seed and IBS.

Acknowledgements

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Appendix

Table 2. Impact of P rates and P placement on plant establishment and yield of canola. Results followed by the same letter are not significantly different.

P-rate (kg/ha)	P Placement	Yield (t/ha)		Plant Establishment Count (plants/m^2)		Oil %	
0	Control	0.20	f	15.8	ns	41.2	ns
15	Below	1.02	ab	13.2	ns	43.0	ns
30	Below	1.23	a	18.0	ns	42.3	ns
45	Below	1.13	ab	19.3	ns	42.5	ns
15	With	0.67	cd	14.6	ns	42.6	ns
30	With	1.05	ab	17.0	ns	42.3	ns
45	With	0.89	bc	13.0	ns	42.4	ns
15	Broadcast	0.45	de	17.6	ns	42.1	ns
30	Broadcast	0.52	de	15.6	ns	41.8	ns
45	Broadcast	0.55	de	19.5	ns	42.0	ns
15	IBS	0.38	ef	15.0	ns	41.7	ns
30	IBS	0.57	de	22.5	ns	42.4	ns
45	IBS	0.60	de	17.8	ns	41.9	ns
	LSD	0.26		7.0		0.9	