GOA Trial Site Report

Phosphorous placement and its effect on establishment and performance of canola

Trail Code: GONU00617-2

Season/year: Winter 2017

Location: Jemalong

Collaborators: David Pengilly

Keywords

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

Take home messages

In soils with low starting phosphorus (P), canola is likely to show a yield response to added P fertiliser.

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

In dry seasonal conditions, placement of P below the seed is likely to bring the most benefit, followed by placement with seed.

In this research 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 research.

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 been applied at planting and mainly is banded in close proximity to seed. P is relatively immobile in the soil and needs to be placed close to crop developing root systems.

Damage to establishing crops by placing P fertiliser close to seed has long been appreciated. For example, trials in 2013 by NSW Department of Primary Industries[1] documented significant reductions in canola establishment with increasing rates of P (up to 20 kg/ha). Yields also increased with increasing rates of P despite emergence suppression. A consequence of emergence damage is unpredictable and variability of plant population, which can make targeting ideal seeding rate difficult. If establishment is more predictable by more appropriate sowing methodology, below ideal plant density can be avoided by more consistent establishment. Profitability is also likely to improve considerably. While, increasing seeding rate can compensate for establishment losses, this comes at a cost to growers and does not increase establishment consistency.

The dilemma is that canola crops require P to optimise yields, however, placing P with seed can lead to significant establishment and yield issues. Past research has not investigated alternate placement options for applying P fertiliser to canola.

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

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

Aims

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

Methods

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

The trial looked at rate of applied P and effect of P placement on germination and yield of canola. All combinations of these variables were able to be assessed via 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:** 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 via the seeder (IBS) – following broadcast onto the soil surface prior to seeding
  - Broadcast - on the soil surface post planting with no incorporation

Table 1. Trial site details

Trial Establishment Date	Autumn 2017	**Seeding rate**	3.6 kg/ha
Crop and Variety	Canola – Hyola 474CL	**Harvest Date**	21/12/2017
Sowing date	29/5/2017	**Row Spacing**	23 cm
Seedling equipment	Double Boot Tyne	**Soil type**	Clay Loam
Nitrogen Crop Nutrition Urea (kg/ha)	??	**Previous Crop**	Wheat
Site Nutrition: Colwell P	0-10 cm: 19 ppm 10-30 cm: <5 ppm	**Pre-Sowing Stubble Management**	Burnt 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

A table of full results are contained in Appendix 1 at the end of the document.

Plant Establishment: Average population across all treatments was high, 54 plants/m^2. There was no significant treatment effect on crop establishment. However there was a non-significant but trend of slightly lower populations where P fertiliser was combined with seed.

Yields: Despite the dry season, adding fertiliser P increased yields by 0.2 to 0.5 t/ha over nil P. Level of response was fertiliser P placement related, as well as being rate responsive (**Figure 1**).

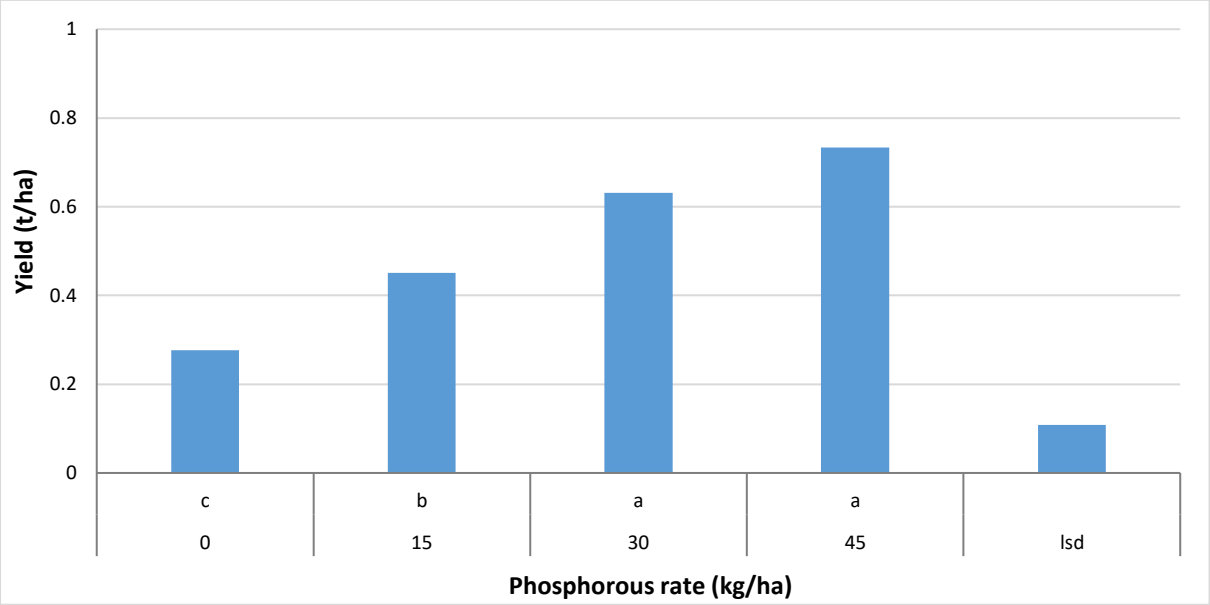

Figure 1. Yields (t/ha) for the four phosphorous application rates (regardless of placement).

There was a yield advantage of ~0.5 t/ha by placing P with or below the seed at sowing when compared to control (nil P) (**Figure 2**). Where P was placed on the soil surface, via post plant and IBS treatments, yield responses respectively were 0.1 and 0.2 t/ha.

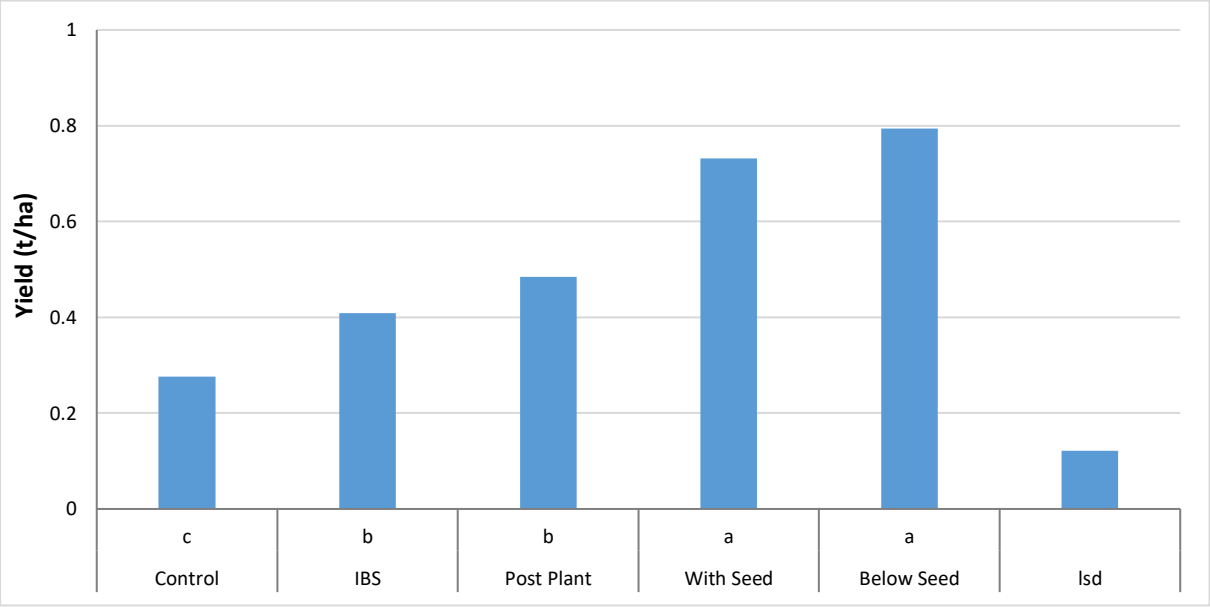

Figure 2. Yields (t/ha) for the four P placement options (regardless of rate). Control is where no P was applied.

There was, to a degree, a similar upward yield response to increasing P rate across all placement options (difference in top-dressed P application methods showed no yield gain from 30 over 15 kg/ha P) . Response was greater where P was added to seed or placed deeper. (**Figure 3**).

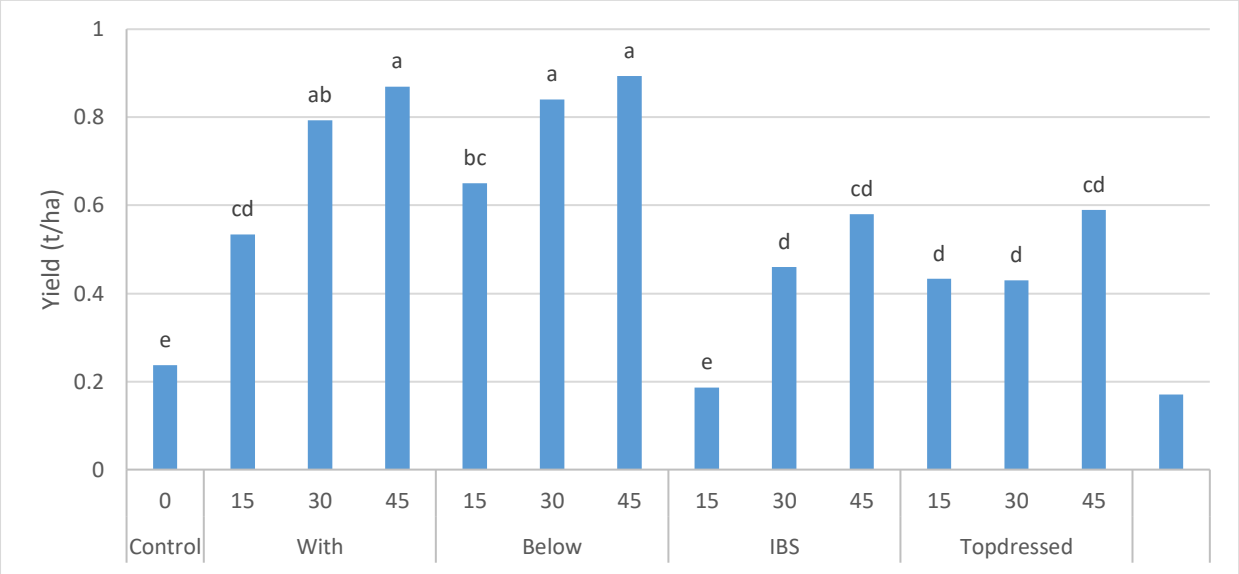

Figure 3. Yields (t/ha) for 3 rates (kg/ha) and the various P placement options. Control is where no phosphorous was applied.

Oil %: The placement of P in this trial caused some treatment differences in oil levels. Where P was placed on the surface (either post plant or IBS) oil percentage was slightly lower than where no P was applied. Where P was applied in a band, either with or below the seed, oil yields were slightly higher.

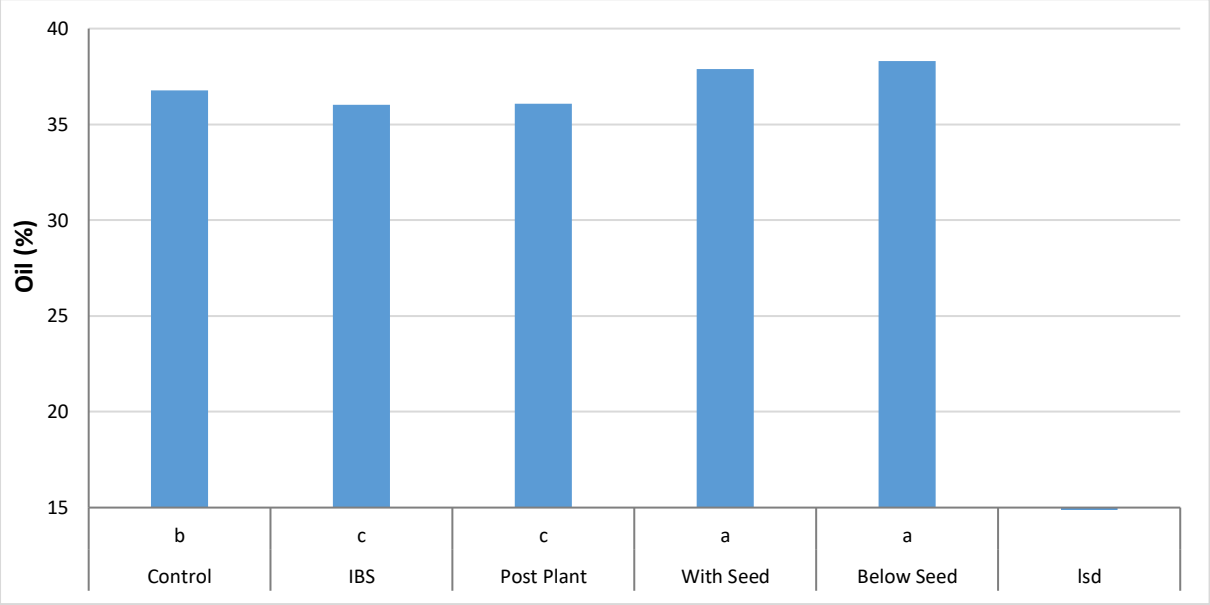

Figure 4. Yields (t/ha) for 3 rates and the various P placement options. Control is where no Phosphorous was applied.

Discussion

This trial was drought affected, and yields reflect it. Although soil P levels were low (Colwell P 19 ppm in surface 10 cm layer and <5 ppm in the 10 – 30 cm soil layer), it might be considered enough to support the low yields (site average of less than 0.6 t/ha) as canola is reported to export about 9 kg/ha per tonne[2] of yield. That there was a yield response at 30 kg/ha would tend to suggest that there are soil P some accessibility issues, possibly exacerbated by the dry conditions.

[2] GrowNote-Canola-North-5-Nutrition. GRDC 2017

There was no significant impact on plant establishment by placing P either with the seed or from any other placement.

P placement, either with or below the seed, were the best yielding placement options. It is likely that banding fertiliser into soil where there was moisture for a longer period during the growing season, allowed canola plants longer access to fertiliser P. Further research would be valuable to test if even deeper application would allow for even further yield gains. It may also be worth gaining a better understanding of the effect of stratification on yields, and if more even distribution of P in the surface 5-10 cm may impact on yields (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 appeared to be above 30 kg/ha, however this may not reflect optimal economic return.

Yields from broadcasting P straight after sowing were better than control (nil P), indicating that despite the dry conditions plants were able, at some stage, to access this fertiliser, indicating some surface root activity. For P applied via IBS it is conceivable that the sowing process dislodged P away from the seed row and hence the lower response (but a response nonetheless).

Placement of P with seed is the main method of application for many farmers in the GOA region, and the P response to the surface applied treatments, investigation into a 'split' treatment may give benefits in terms of reduced impacts on establishment, improved logistics at sowing and possibly yield improvements.

Conclusion

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

While not reflected in this trial, placement of P with seed can adversely impact germination, even at lower rates. Where possible it is advised to consider alternative placement technology. Establishment loss from P placed with seed can be mitigated by raising sowing seed rate. However increased sowing rates adds to cost, and unpredictability of likely stand density.

In dry seasonal conditions, placement of P below the seed is likely to provide 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 split the application between a broadcast of P ahead of sowing and at sowing warrants more testing.

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 GRDC. The authors would like to thank them for their continued support. Special thanks goes to David Pengilly from Jemalong who hosted this trial.

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/m2)		Oil %	
15	Below	0.65	ns	49.5	ns	38.4	ab
30	Below	0.84	ns	52.2	ns	37.83	abc
45	Below	0.89	ns	53.1	ns	38.7	a
0	Control	0.28	ns	58.5	ns	36.77	de
15	IBS	0.19	ns	58.2	ns	36.43	def
30	IBS	0.46	ns	53.1	ns	35.4	f
45	IBS	0.58	ns	53.9	ns	36.2	def
15	Topdressed	0.43	ns	61.6	ns	35.77	f
30	Topdressed	0.43	ns	53.6	ns	35.83	ef
45	Topdressed	0.59	ns	55.6	ns	36.6	cef
15	With	0.53	ns	48.3	ns	37.33	bcd
30	With	0.79	ns	49	ns	38	ab
45	With	0.87	ns	53.9	ns	38.3	ab
	lsd						