GOA Trial Site Report

Phosphorous placement and its effect on establishment and performance of canola

Trail Code: GONU00618-2

Season/year: Winter 2018

Location: Canowindra

Collaborators: Rob Atkinson and Col McMaster (NSW DPI)

Keywords

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

Take home messages

Even in soils with moderate phosphorus (P), canola is likely to show a 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, splitting application or compensate by adjusting seeding rate.

In dry seasonal conditions, P placement below the seed is likely to yield best, followed by placement with seed.

There was a yield response, albeit small, to surface applied P even in these very dry conditions. The option to split application (reducing amount of P placed with seed) and broadcasting the balance prior to sowing, warrants more testing.

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 commonly based on the understanding that P is relatively immobile in the soil and needs to be placed close to developing crop root systems.

Damage to establishing crops by placing starter fertiliser close to seed is known. Trials in 2013 conducted by NSW Department of Primary Industries[1] demonstrated significant reductions in canola establishment with increasing rates of P (up to 20 kg/ha). As canola seed is expensive, particularly for hybrid varieties, this can result in a direct seed 'cost'.

Yields also increased with increasing rates of P despite suppression in emergence. A consequence of unpredictability and variability in establishment density, is making targeting of an ideal seeding rate difficult if not impossible. Unpredictable plant establishment can result in very poor stands with

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

consequent major yield losses. Increasing seeding rate can compensate for establishment losses but this comes at a cost and does not avoid unpredictable plant density.

The dilemma therefore is that canola crops require P to optimise yields, however, placing P with seed can lead to significant issues. Previous research has not assessed alternate placement options for applying P fertiliser to canola crop.

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

Aims

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

Methods

Trial design was a small plot, full factorial randomised complete block design with three replicates established in autumn 2018.

The following treatments were applied.

- **Rates:** Three rates of P in form of triple superphosphate (Trifos) were applied at 0, 10, 20 and 40 kg/ha of P.
- **Placement:** P fertiliser the following methods and repeated for all P rates -
    - Below the seed - in a band approximately 6 cm below the soil surface and 4 cm directly below the seed, applied in the same sowing pass
    - With the seed - banded with the seed in the same sowing pass
    - IBS - Broadcast onto the soil surface prior to seeding to be incorporated by the seeder (IBS)
    - Broadcast - on the soil surface post planting with no incorporation
    - Split - base rate of 10kg/ha P with the seed and the remainder IBS (only at the 20 and 40 rates)
    - Control – no P applied, but all application methods used.

Table 1. Trial site details

Trial Establishment Date	Autumn 2018	**Seeding rate**	2.8 kg/ha
Crop and Variety	Bonito TT	**Harvest Date**	26/11/2018
Sowing date	15/5/2018	**Row Spacing**	27.5 cm
Seedling equipment	Knife point press wheel	**Soil type**	Sandy Clay Loam
Site Nutrition: Colwell P	0-10 cm: 36	**Pre-Sowing Stubble Management**	Standing stubble, direct drilled

Results were analysed using ASREML 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 of the full results are detailed in Appendix 1.

Plant Establishment: Average population was 50 plants/m^2. Placement of P 'with' seed did reduce plant establishment at 10 and 40 kg P/ha rates. Where 40 kg/ha was applied with seed a 22% reduction in establishment compared to control occurred. Application using the split, IBS and broadcast treatments did not result in any reduction in populations compared to the control. There was also a small reduction in establishment where 10 and 20 kg/ha P was place below the seed (see Annex 1).

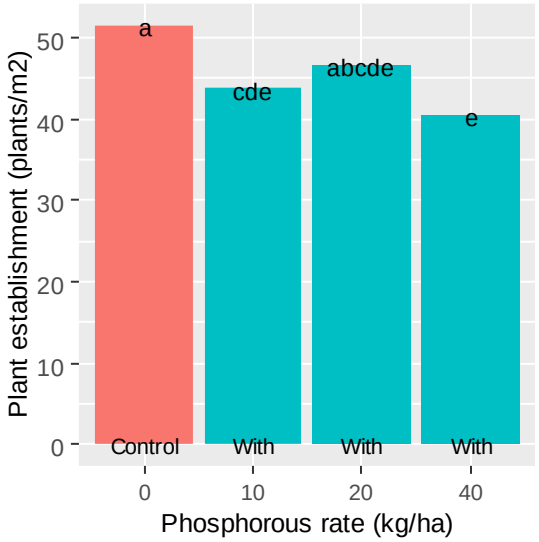

Figure 1. Plant establishment (plants/m^2) for control and 'with seed' placement treatments, Canowindra 2018.

Yields: Varied from 0.5 to 0.8 t/ha. All treatments out yielded control. Highest yield (0.8 t/ha) was 40 kg/ha P placed below the seed. Although there were differences in yields 'within' each placement option, none were significant, i.e. 10 and 40 kg/ha P placed 'below' did not yield differently. There were however differences within rates, i.e. 20 kg/ha P Below the seed (0.8 t/ha) compared to 20 kg/ha P with seed (0.66 t/ha) (**Figure 2**).

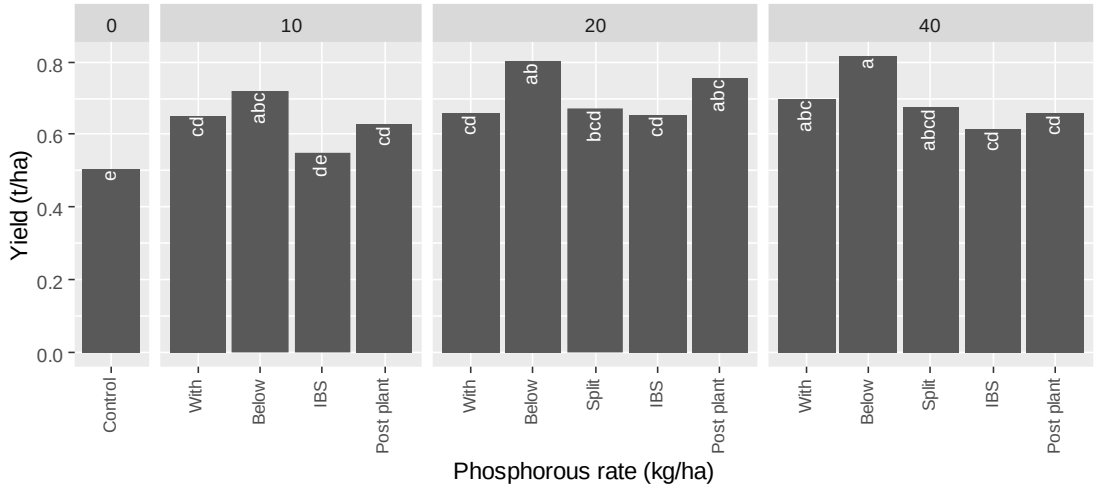

Figure 2. Yields (t/ha) for the various P application rates (kg/ha) and placement options. Canowindra 2018.

Yield data for P placement (regardless of rate), indicated there was no yield penalty from placing P away from the seed compared to the 'with' treatment. There was a difference between placing P below the seed (0.8 t/ha) and IBS (0.6 t/ha) (**Figure 3**).

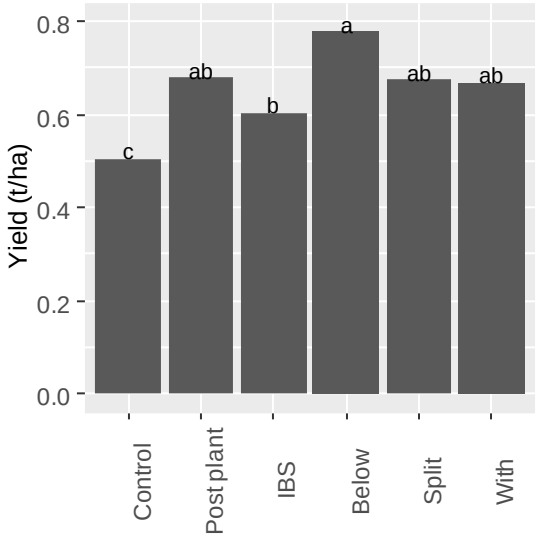

Figure 3. Yields (t/ha) for the various placement options (regardless of rate). Control has no P applied.

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

Discussion

The site had moderate initial P levels with a Colwell P of 36 ppm in the surface 10 cm layer. Even at these modest levels in a dry year there was still a yield response to both P rate and placement.

The impact on establishment from placing P with seed was minor in this trial, and the high overall populations overshadowed any flow on yield affects.

Placement of P with canola seed is likely to be the main application method for many farmers in the GOA region. All three alternative placement options (Below, IBS and Post plant) resulted in similar yields, as did the Split treatment. Placement of P below seed yielded highest in the trial. P below seed also resulted in highest yield for each P rate increment (not always significant).

Placement of P on the soil surface either IBS or broadcast post sowing both resulted in yield responses compared to control. This would suggest that canola plants can develop shallow roots to exploit surface applied P even in dry seasons.

Split P application option (10 kg/ha P with seed and the remainder IBS) may prove to be a workable solution to growers who want to minimise potential for establishment losses (and implications for seed costs) but may not have appropriate equipment to place P below seed. This option is likely to also have implications for sowing efficiencies, as IBS position could be applied in downtimes prior to or even post sowing.

Placement of P below seed was the best performing treatment. It is likely that deeper placement (4-6 cm below the seed) placed P fertiliser into moist soil where it remained moister for a longer period during the growing season, and hence, allowed longer access to fertiliser P source. It would be valuable to assess if even deeper placement would allow for even further yield gains. It is also plausible that having P evenly distributed in the surface 5-10 cm may also result in 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 10 and 20 kg/ha, however, this may not necessarily reflect the optimal economic return.

Conclusion

Even in soils with moderate starting P, canola showed a significant yield response to added P fertiliser.

While not strongly reflected in this trial, P placement with seed can impact on germination, even at lower P rates. Where possible growers are urged to consider alternative P placement or compensate by adjusting seeding rate.

In dry seasonal conditions, P placement below seed is likely to result in greatest yield gain, followed by placement with the seed (though note comment above).

There was a yield response, to surface applied P even in very dry conditions. Broadcast P ahead of sowing option warrants more testing in conjunction with a split application.

Acknowledgements

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Appendix

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

Phosphorous		Plant establishment		Vegetation index		Yield		Admix		Protein		Test Weight		Oil	
Placement	Rate	(plants/m2)		(NDVI)		(t/ha)		(%)		(%)	(%)	(kg/hl)		(%)	
	(kg/ha)	p.v.[1]	s1[2]	p.v.[1]	s1[2]	p.v.[1]	s1[2]	p.v.[1]	s1[2]	p.v.[1]	s1[2]	p.v.[1]	s1[2]	p.v.	s1
Control															
	0	51	a	0.41	f	0.50	e	0.8	bc	25.9	a	66.6	f	39.2	b
IBS															
	10	53	ab	0.42	ef	0.55	de	0.7	bc	25.2	ab	67.1	cdef	39.2	ab
	20	46	abcde	0.46	abc	0.65	cd	1.1	ab	25.5	ab	67.3	bcdef	40.0	ab
	40	53	abc	0.44	bcde	0.61	cd	0.5	c	26.0	ab	66.8	def	39.1	ab
Split															
	20	49	abcde	0.44	bcde	0.67	bcd	0.8	abc	25.7	ab	67.7	abcde	40.0	ab
	40	47	abcde	0.46	abc	0.68	abcd	0.7	bc	25.3	ab	68.5	ab	39.9	ab
Below															
	10	44	bde	0.42	def	0.72	abc	0.9	abc	25.0	b	67.5	abcdef	39.9	ab
	20	43	de	0.44	bcde	0.80	ab	0.8	bc	25.2	ab	68.2	abc	40.0	ab
	40	47	abcde	0.48	a	0.81	a	0.6	c	25.0	b	68.7	a	40.1	ab
With															
	10	46	cde	0.44	cde	0.65	cd	1.0	ab	25.6	ab	67.6	abcde	39.2	ab
	20	47	abcde	0.47	ab	0.66	cd	1.0	ab	26.0	ab	67.7	abcde	39.2	ab
	40	40	e	0.47	ab	0.70	abc	0.8	abc	25.6	ab	68.6	ab	40.0	ab
Post plant															
	10	54	a	0.44	cdef	0.63	cd	1.2	a	25.4	ab	66.7	ef	40.1	ab
	20	52	abcd	0.45	abcd	0.75	abc	0.8	bc	25.2	ab	68.0	abcd	40.2	a
	40	50	abcd	0.47	abc	0.66	cd	0.8	abc	25.4	ab	68.6	a	39.5	ab
lsd															
	lsd	9		0.03		0.14		0.4		1.1		1.3		1.3	

[1] predicted value
[2] values with the same letter for each variable are not significantly different