GOA Trial Site Report

Phosphorous fertiliser rate and placement and its effect on establishment and performance of canola

Trail Code: GONU00516-4

Season/year: Winter 2016

Location: 'Bridgewater' Alectown

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Keywords

GONU00516-4, phosphorus, deep banding, IBS, canola, germination, establishment, Alectown

Take home messages

Placement of P with seed can adversely impact germination, even at lower P rates. Where possible growers should consider alternative placement or compensate by adjusting seeding rate.

Check soils for acid bands as these can also adversely impact on canola yield.

Trial yield trends were similar regardless of whether the P was placed below, with or above the seed.

Broadcasting P ahead of 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 mainly has been banded in close proximity to seed. This approach is based on the perception that fertiliser P is relatively immobile in the soil and needs to be placed close to the developing crop root systems.

Damage to establishing canola crops by placing fertiliser P close to seed has long been accepted. For example, trials in 2013 by NSW Department of Primary Industries[1] demonstrated 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. However, P applied with seed requires increased seeding rate to compensate for establishment losses and to maintain adequate plant density. Additional seed is a significant cost to growers. Also is the unpredictability and variability of seedling loss caused by banding fertiliser P with canola seed can make canola management more challenging. Targeting an ideal seeding rate is especially difficult because of variability in seedling loss when banding P with seed. Very poor density stands may occur in these situations and low density can prevent canola crops reaching their yield potential.

The dilemma therefore is that canola crops mainly require fertiliser P to optimise yield, but placing it with the seed can lead to significant issues like loss of seedlings. Previous research did not investigate alternate 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 and also there is an opportunity with any sowing equipment to broadcast fertiliser either pre or post seeding. This trial is designed to investigate if the application of P using these alternate methods of P placement could avoid damage at establishment while maintaining the crop P fertiliser requirements.

Aims

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

Methods

The trial was a small plot, full factorial randomised complete block design with three replicates established in the autumn of 2016.

Trial design aimed to assess rate of P and effect of P placement on germination and canola yield. All combinations of these variables were able to be assessed because of 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 by sowing following broadcast (IBS) - 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 2016	Seeding rate	0.8 & 2.5 kg/ha
Crop and Variety	Canola – 44Y89	Harvest Date	22/11/2016
Sowing date	4/5/2016	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	Barley
Site Nutrition: Colwell P	0-10 cm: 10 ppm 10-60 cm: <5	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

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

Plant Establishment: Placement of P with seed significantly reduced plant establishment by 27% (Figure 1). There was no significant impact of phosphorus rate on plant establishment, however, there was an interaction where P was placed with seed (at either 15, 30 or 45 kg/ha). The higher the P rate, up to 30 kg/ha, the lower establishment tended to be.

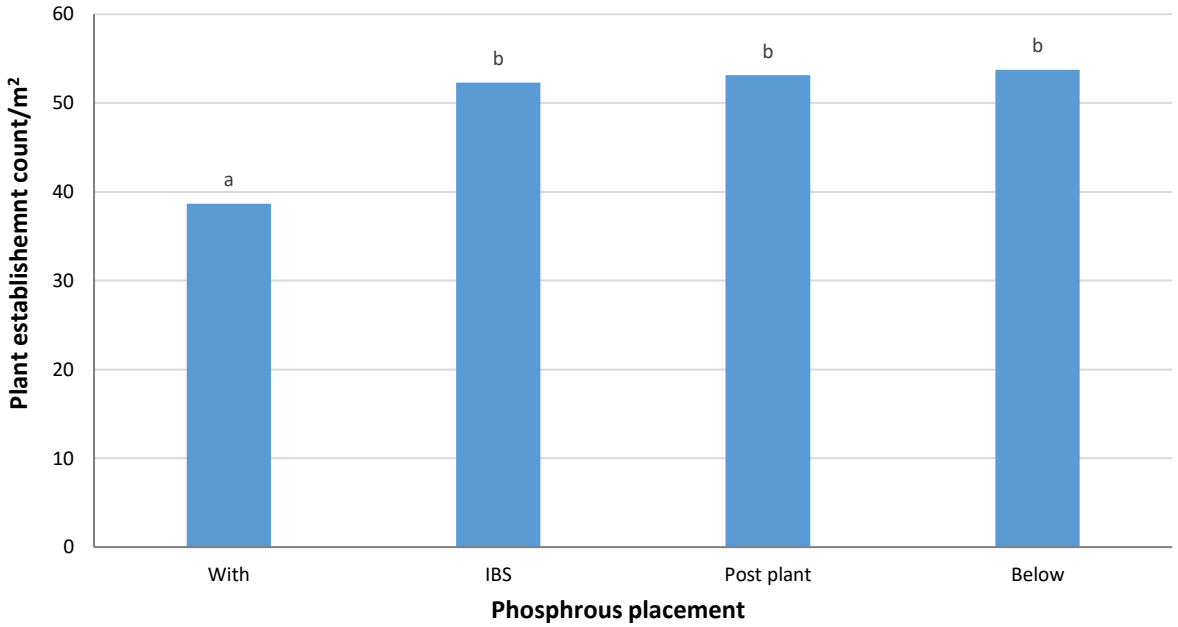

Figure 1. Plant population (plants/m^2) 21 days after sowing (DAS)

Yields: In P treatments yields were more than 0.5 t/ha greater than nil P. However, there was no statistically significant yield differences between the placement options and no interaction of P related to rate and placement.

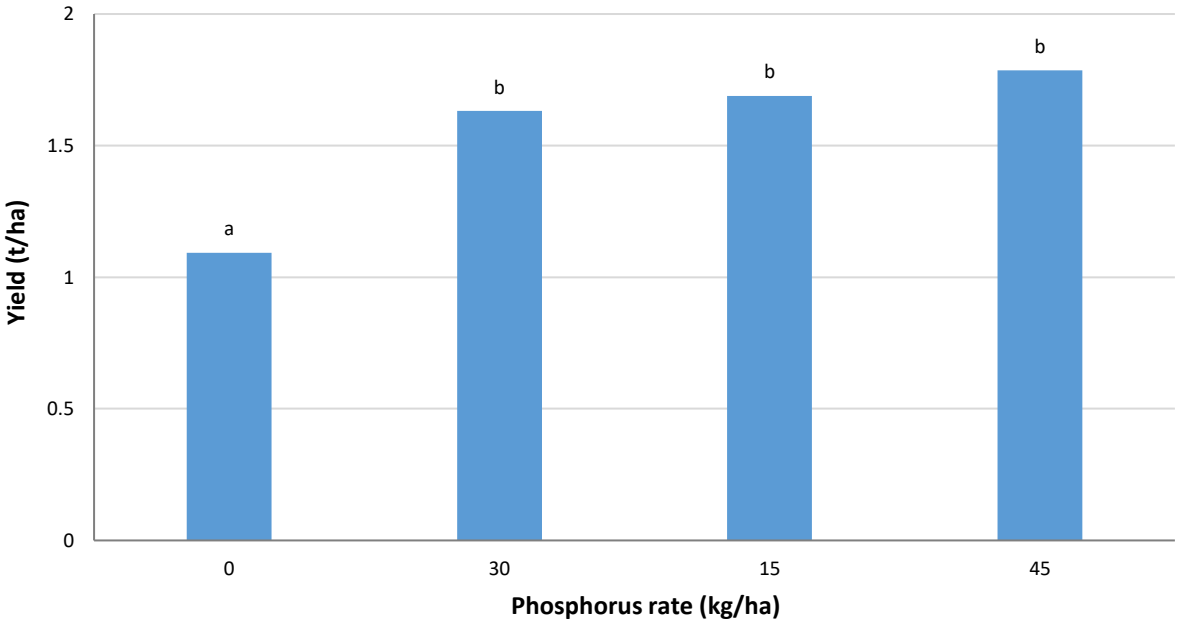

Figure 2. Yields (t/ha) for the four application rates (regardless of application placement).

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

Discussion

Yield and plant population differences between treatments were likely limited by an acid band 5-15 cm from the soil surface, where pH was 4.2 and aluminium saturation was 38%. The following observations from this trial take this into account.

For treatment uniformity all plots were subject to soil disturbance via an identical treatment needed for deep banding application of P. It is conceivable that the loosening of the soil with this operation may have allowed for more separation of seed and P where it was intended to be placed together (banded with seed treatment). Therefore it is possible that farmers with a single tyne/boot system may experience greater levels of seedling loss where there may be less separation than occurred in this trial.

Reduction in plant emergence because of P placement with seed in this trial is consistent with NSW DPI findings and also confirmed that placement either below the seed or on the surface (broadcast or IBS) did not have any adverse germination impacts. Reduced emergence of about 33% is equivalent to an economic loss of around $20/ha in seed costs alone. Particularly noteworthy is that reduced emergence occurring at the lowest P rate tested (15 kg/ha). This rate is commonly considered to be the base rate used in the Orana region. This alone is key data and has clear implications for P management in canola crops.

There was a yield response to applied P throughout the trial, however, the response did not increase beyond the lowest P rate tested (higher rates of P did not result in further increased yield). That the yield response was limited to the lowest rate is likely to be a direct result of the extreme acid band referred to above.

Even though P placed with seed reduced establishment, it did not result in a reduced yield compared to other P placement options. This indicates remaining plants were able to compensate. Plant establishment overall was high and a reduction still resulted with a population considered acceptable (30-50 plants/m^2) and within the range recommended[2] by NSW DPI.

There was also no yield penalty from P placement on the soil surface, nor banded under the seed. Response from the surface applications is somewhat unexpected as P is well known to be immobile in the soil. However, 2016 was one of the wettest winters on record (272 mm[3] was recorded in May, June and July), and it is possible that rainfall not only dissolved some of the P into the soil, but also allowed for roots to be active at the soil surface for extended periods.

Conclusion

Placement of P with canola seed can adversely impact germination, even at lower rates. Where possible growers should consider alternative placement or compensate by adjusting seeding rate.

The option to broadcast P ahead of sowing warrants more testing.

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[2] http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/winter-crop-variety-sowing-guide

[3] Bureau of Meteorology station number: 50117 Station name: ALECTOWN (BRIDGEWATER), approx. 4 km from trial site

Check soils for acid bands.

The trial did not show a statistically significant increase in yield to increasing P rate although a trend did exist. As the trial was not clearly responsive to P application no conclusions can be drawn as to the relative efficiencies of applying P fertiliser either above or below the seed. But yields tended to follow the same upwards trend to increasing P rates regardless of placement. This observation requires further investigation.

Acknowledgements

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Appendix

Table 2. Impact of plant populations, P rates and P placement on yield and % oil 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)	
0	Below	2.12	a	32.9	bcd
15	Below	2.52	abc	39.8	d
30	Below	3.04	de	31.6	bcd
45	Below	2.78	bcd	34.8	bcd
0	IBS	2.30	a	32.9	bcd
15	IBS	2.77	bcd	39.0	cd
30	IBS	2.77	bcd	35.4	bcd
45	IBS	3.39	e	33.9	bcd
0	Post plant	2.26	a	27.6	b
15	Post plant	2.83	cd	30.7	bcd
30	Post plant	3.04	de	35.1	bcd
45	Post plant	3.35	e	35.3	bcd
0	With	2.39	ab	33.4	bcd
15	With	2.40	abc	28.7	bc
30	With	3.01	de	19.6	a
45	With	2.41	abc	19.8	a