GOA Trial Site Report

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

Trail Code: GONU00616-2

Season/year: Winter 2016

Location: "Inglewood" Gilgandra

Collaborators: Tex and John Kilby

Keywords

GONU006, phosphorus, deep banding, IBS, canola, germination, establishment, Gilgandra

Take home messages

Placing high rates of P with canola seed can negatively impact germination. The impact on establishment can follow through to yield. Placement of P away from the seed mitigated both these effects.

Placement of fertilizer on the soil surface did not result in a yield penalty in a 'wetter than average' year, and as an application option warrants further investigation.

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 only been applied at planting and often is banded with or near seed. This approach is mainly because P in fertiliser is relatively immobile in the soil and needs to be placed close to the developing root systems.

Damage to establishing canola crops 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 rates of P despite suppression in emergence. However, it requires an increased seeding rate to compensate for establishment losses and achieve acceptable plant stands. This is a significant cost to growers. Also unpredictable and variable plant density makes targeting an 'ideal' seeding rate difficult if not impossible. Fertiliser P placed with seed, commonly results in very poor stand density that can result in crops that are unable to reach their full yield potential.

The dilemma therefore exists, canola crops require P fertiliser in many situations to optimise yields but placing it with the seed can lead to significant issues. Previous research has not investigated alternate options for applying P fertiliser to canola crops and therefore the need for this study.

Some modern seeders have the ability to band fertiliser below the seed while for others there is the opportunity to broadcast fertiliser either pre or post seeding. This trial is designed to investigate if the

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

application of P using these alternate methods or placement could avoid damage at establishment while maintaining P fertiliser responsiveness.

Aims

Determine if varying the placement and rate of P fertiliser can reduce negative impact on crop 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 2016.

The trial aimed to assess rate of P and P placement on germination and canola yield. All combinations of P rate/ha and fertiliser placement (with seed, below seed and two top-dress strategies) were used 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 (IBS)
  - 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	3/11/2016
Sowing date	21/4/2016	Row Spacing	27.5 cm
Seedling equipment	Double Boot Tyne	Soil type	Sandy Clay Loam
Nitrogen crop nutrition (kg/ha)	200 (seeding) + 90 (top-dressed) Urea	Previous Crop	Oats
Site Nutrition: Colwell P	0-10 cm: 18 ppm 10-60 cm: <5	Pre-Sowing Stubble Management	Cultivated

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: Where P was placed with the seed, establishment counts were lower than where P was placed away from the seed (Figure 1) at the 30 kg/ha rate where establishment was reduced by one third. Placement of P away from seed did not affect plant establishment.

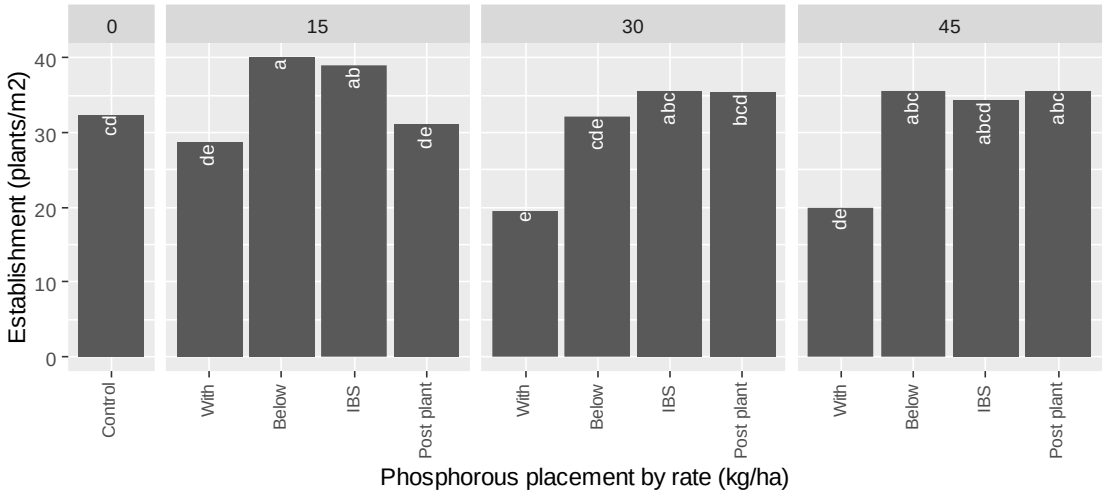

Figure 1. Plant establishment (plants/m^2) 35 days after sowing (DAS).

Yields: There was a positive yield response to P application, particularly for surface applied P. Where no P was applied yield was 1.8 t/ha compared to 2.6 t/ha where P was applied to the soil surface (**Figure 2**). There was a significant yield interaction between placement of P and rate applied. At the highest P rate (45 kg/ha), placement with the seed significantly reduced yields compared to post sowing surface and IBS P application.

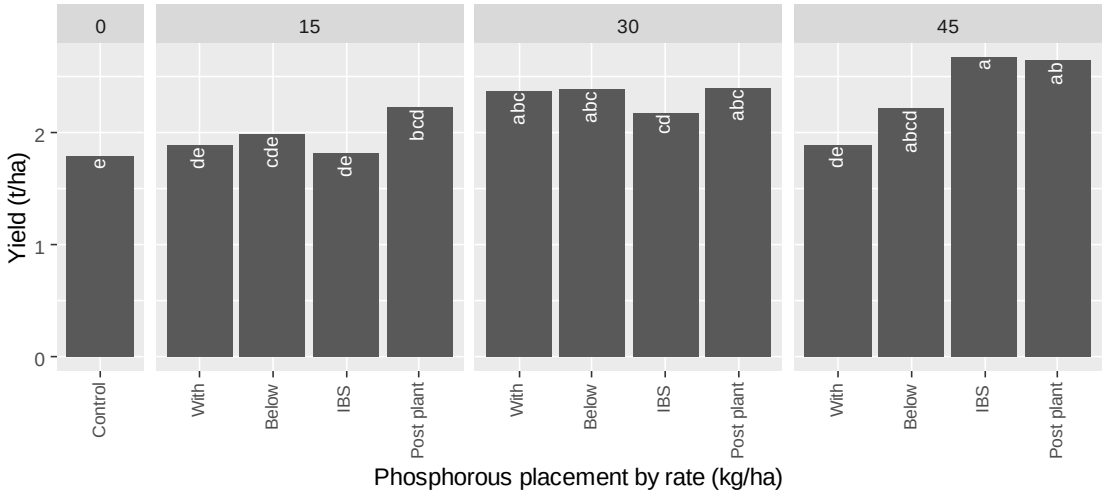

Figure 2. Yield response from P placement techniques and 4 rates of applied P

Oil and Protein %: There was no influence of P rate or placement on oil or protein content.

Discussion

At this site a deep blade system (DBS) was used to apply P in the "below" seed placement treatment. For consistency DBS treatment (without P fertiliser) was also applied to all other placement options. It is conceivable that the loosening of soil with DBS may have allowed for more separation of seed and P compared to where it was placed together. Increased moisture loss may have also disadvantaged shallower P application methods. It is possible that farmers with conventional tyne/boot or disc systems where seed and fertilizer separation is less may experience poorer crop establishment.

The reduction in plant emergence because of placement of P fertiliser with seed is consistent with previous NSW DPI findings. Testing alternative placement options confirmed that moving P away from seed can reduce the adverse impact on establishment.

The plant emergence, averaged for the three rates of P applied with the seed, was about 33% less than where no P was applied. This has the potential to result in a significant economic loss, particularly when factoring in the cost of the seed and the yield reductions.

Starting P levels at this trial were on the low side (18 ppm in the 0-10 cm topsoil), with yield response to applied P up to the highest rate of 45 kg P/ha. P response was greater where P was spread on the soil surface (either post sowing broadcast or IBS). It is possible that in this wetter season canola roots were able to explore for the P over a larger portion of soil mass including close to the surface than where banded. This site had a 'liberal' application of N (290 kg/ha urea) and was only in its second crop following a lucerne phase (soil tests showed approximately 130 kg N to 60 cm depth). Nitrogen should not have limited yields.

The response from the surface applications is somewhat unexpected. P is well known to be immobile in the soil, however, 2016 was one of the wetter winters on record. Conditions at sowing were favourable, more than 25 mm of rain fell in the week prior to planting, and a further 60 mm 10 days after. During the growing season there was approximately 580 mm rain. It is possible that the rainfall early in the season moved some of fertilizer from the soil surface into the soil and allowed for canola roots to be active at the soil surface for extended periods.

Conclusion

Placement of P with seed negatively impacted plant establishment and reduced yield compared to top-dressed at the higher P rates. Placing P on the soil surface (either IBS or post sowing broadcast) had no negative effect on establishment and the most positive effects on yields.

Application of P away from the seed can be an effective strategy to improve crop establishment and yields.

There was a clear response to P, indicating that growers who use a high Nitrogen strategy may need to consider higher rates of P to optimise yields.

Acknowledgements

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them for their continued support. Special thanks go out to the Kilby family from Gilgandra who hosted this trial.

Appendix

Table 2. Impact of plant populations, P rates and P placement on various aspects of canola production. 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	32	ab	0.47	cd	1.78	e	1.2	a	21.0	b	66.9	a	44.8	b
IBS															
	15	39	a	0.51	abcd	1.81	de	1.4	a	21.1	ab	68.1	a	45.0	ab
	30	36	ab	0.52	abcd	2.17	cd	1.3	a	20.9	ab	67.2	a	45.5	ab
	45	34	ab	0.53	abcd	2.66	a	1.2	a	21.8	a	66.6	a	44.8	ab
Below															
	15	40	a	0.53	abcd	1.98	cde	1.5	a	21.3	ab	67.2	a	45.1	ab
	30	32	ab	0.58	a	2.39	abc	1.2	a	20.8	ab	67.9	a	45.2	ab
	45	36	ab	0.56	ab	2.21	abcd	1.4	a	21.3	ab	66.1	a	45.0	ab
With															
	15	29	bc	0.48	bcd	1.89	de	1.4	a	21.2	ab	66.3	a	45.6	a
	30	20	c	0.54	abc	2.36	abc	1.4	a	21.4	ab	66.6	a	45.5	ab
	45	20	c	0.45	d	1.89	de	1.2	a	21.2	ab	66.7	a	44.7	ab
Post plant															
	15	31	ab	0.51	abcd	2.22	bcd	1.1	a	20.8	ab	68.8	a	45.3	ab
	30	35	ab	0.51	abcd	2.39	abc	1.5	a	20.6	b	69.1	a	44.6	b
	45	36	ab	0.57	ab	2.63	ab	1.4	a	20.5	b	66.3	a	45.2	ab
lsd															
	lsd	10		0.09		0.41		0.4		1.0		3.6		0.9	

[1] predicted value

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