Trial site report.

Canola - fine tuning phosphorus management.

Grain Orana Alliance

Trial code:	GANU02624-3
Season/year:	Winter 2024
Farm name and location	Bellevue
Collaborators:	Brill Ag
Co-operator:	Charlie Baldry

Keywords

GANU026, phosphorus, establishment, canola, Wallendbeen

Take home messages

- Canola can access soil surface applied phosphorus (P), particularly in high rainfall environments where the soil surface remains moist due to the micro-climate created by the canola canopy.
- Canola's early vigour may be reduced where P is broadcast, but this had no effect on final yields.
- Split P applications, e.g. 5 kg P/ha with seed + remainder immediately before sowing (IBS), can reduce establishment risks, while maintaining crop yield and grain quality.
- Splitting P applications affords growers greater sowing efficiency, with less fills of the seeder.

Background

Grain Orana Alliance (GOA) has conducted more than 24 trials over the past 7 years at options to reduce damage from starter fertiliser in canola.

Some of the key findings from previous trials include:

- canola establishment can be negatively affected by P rates as low as 10 kg/ha (~50 kg MAP)
- deep banding fertiliser more than 2 cm below seed generally avoids damage, except at very high rates
- surface-applied P (pre- or post-sowing) avoids establishment issues and does not usually reduce yield
- yield loss from surface P only occurred in very dry seasons with limited surface root activity.

Recently, GOA has focused on evaluating the effects of split P applications - applying a small, safe amount with the seed as starter P to support establishment and early vigour, and applying the remaining P by either incorporated by sowing (IBS), spreading on the soil surface, or top-dressed 4-8 weeks after sowing.

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Some benefits from increased P application flexibility include:

- reduced establishment risk, especially in dry or marginal conditions
- increased seeding efficiency (fewer fertiliser refills)
- alternatives for growers without deep banding equipment.

This trial aims to substantiate prior research and give growers the confidence to apply the P required for maximal yield potential in a way that reduces establishment risk and increases the flexibility of P applications.

Aims

To investigate in canola if broadcasting P by IBS is as efficient for grain yield and quality compared to when the P is placed in a band below the seed.

Treatment descriptions

Key trial information is listed in Table 1

Table 1: Trial information

Activity	**Date**
Sowing date	18-4-2024
Harvest date	26-11-2024
Equipment	Small plot seeder with DBS parallelogram tines.
Row spacing	0.25 m

Treatment notes:

- The aim of this trial was to examine the efficiency of P application methods, knowing that P applied near seed will reduce canola establishment. Treatments in Table 2.
- P was applied at rates of 0, 5, 10, 20 and 40 kg/ha (MAP rates of 23, 46, 92 and 184 kg/ha)
- Fertiliser at 3 different placements:
  1. below the seed: P applied through fertiliser boot of DBS tine and seed applied through separate seed boot (~1.25 cm vertical separation)
  2. incorporated by Sowing (IBS): P broadcast (by plot seeder) pre-sowing then sown
  3. Split: 5 kg/ha P (23 kg/ha MAP) applied through the fertiliser boot and the balance of the P rate applied IBS.

Nitrogen, sulfur and potassium were applied to ensure other macronutrients were non-limiting.

Table 2: Phosphorus placement and rate (kg/ha) treatments.

Rate	Placement
Nil	Control
5	Below
10	Below
20	Below
40	Below
5	IBS
10	IBS
20	IBS
40	IBS
10	Split
20	Split
40	Split

Site Selection

The site was selected because it has been intensively cropped and known to be a P responsive paddock. Subsequent soil testing showed moderate levels of P (Table 3).

Table 3: Soil test data for the selected site.

Depth	pH (Ca)	OC %	Nitrate	Ammonium	P (Colwell)	Sulfur	Conductivity
cm			mg/kg	mg/kg	mg/kg	mg/kg	dS/m
0-10	5.5	2.8	51	23	29	14	0.162

Rainfall

- There was good rain in the 2023/2024 fallow period resulting in a close to a full profile of moisture at sowing. The trial established well with April rainfall.
- Rainfall in July-October was below average, but with the stored water from the fallow period, yield potential was still high. (Table 4).

Table 4: Monthly rainfall[1] (mm) and long-term average (LTA) at trial site.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2024	184	47	24	78	42	55	42	36	31	28	74	71	**712**
LTA	57	48	51	50	58	62	67	64	56	65	57	57	**692**

Results

Plant establishment

- PY525G was sown at 3 kg/ha, targeting a plant density of 45 plants/m² (assuming 60% establishment rate).
- There was no effect of P rate or placement on canola establishment. The average establishment was 53 plants/m² (70% establishment rate).

Vegetation index

A higher Normalized Difference Vegetation Index (NDVI or VI) indicates healthier and more vigorous vegetation.

Vegetation index was measured at 39, 47, and 56 days after sowing (DAS) (Figure 1).

- A clear P response was measured with higher NDVI as the P rate increased.
- Early season, the IBS and Split P treatments had a lower VI than where the P was placed Below seed. This was more evident at lower P rates. The Split P treatments generally caught up to the Below treatments later in the season, but the lower rates of P (5-20 kg/ha P) applied IBS had lower NDVI values.

[1] Gridded data for the trial site from: Access Gridded Data | LongPaddock | Queensland Government

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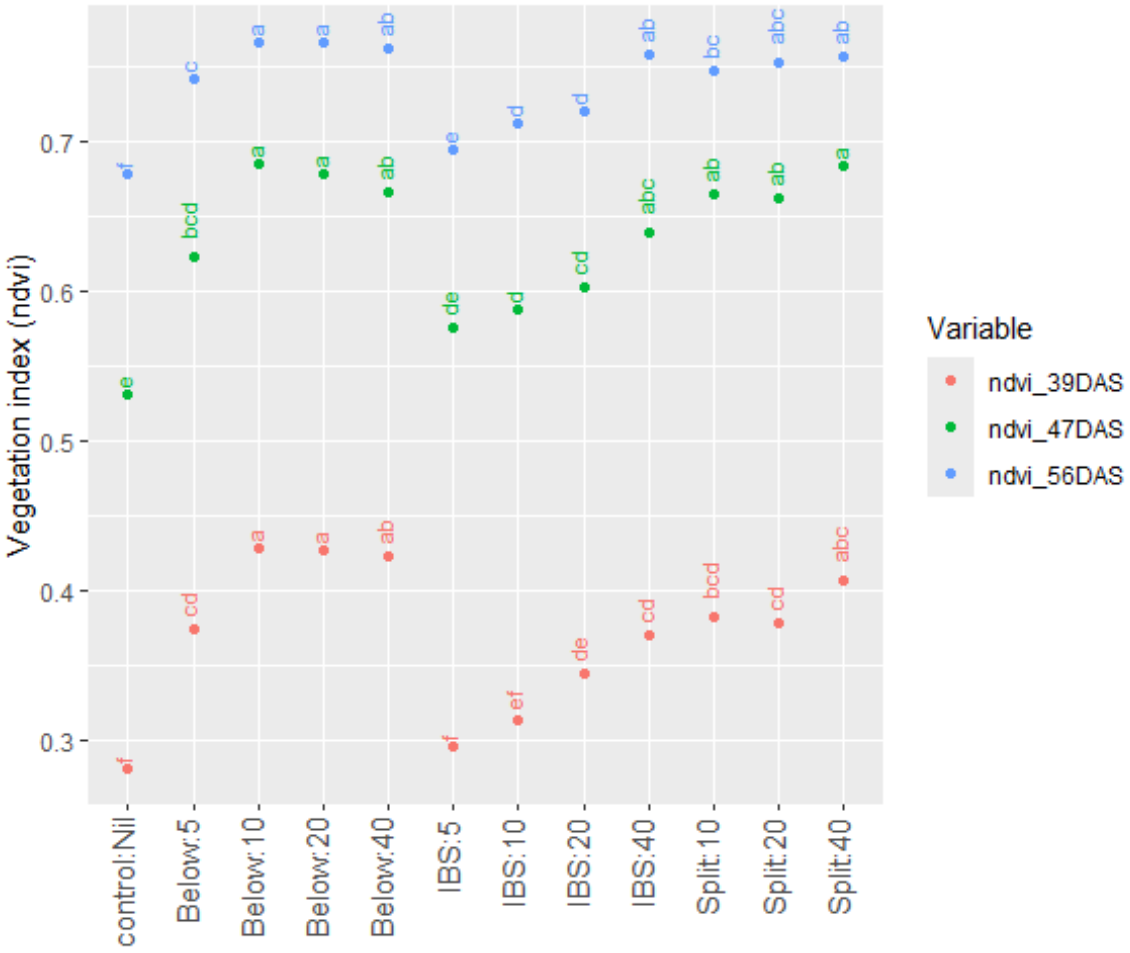

Figure 1: Vegetation index assessed 38, 69, and 111 DAS. Treatments with the same letter are not significantly different.

Grain yield

- Grain yield increased from 3.3 t/ha with 0 P applied, to 3.9 t/ha with 40 kg/ha P applied (averaged across placements).
- Within each P rate, there was no yield difference between P placement methods, despite the early season differences in crop NDVI.

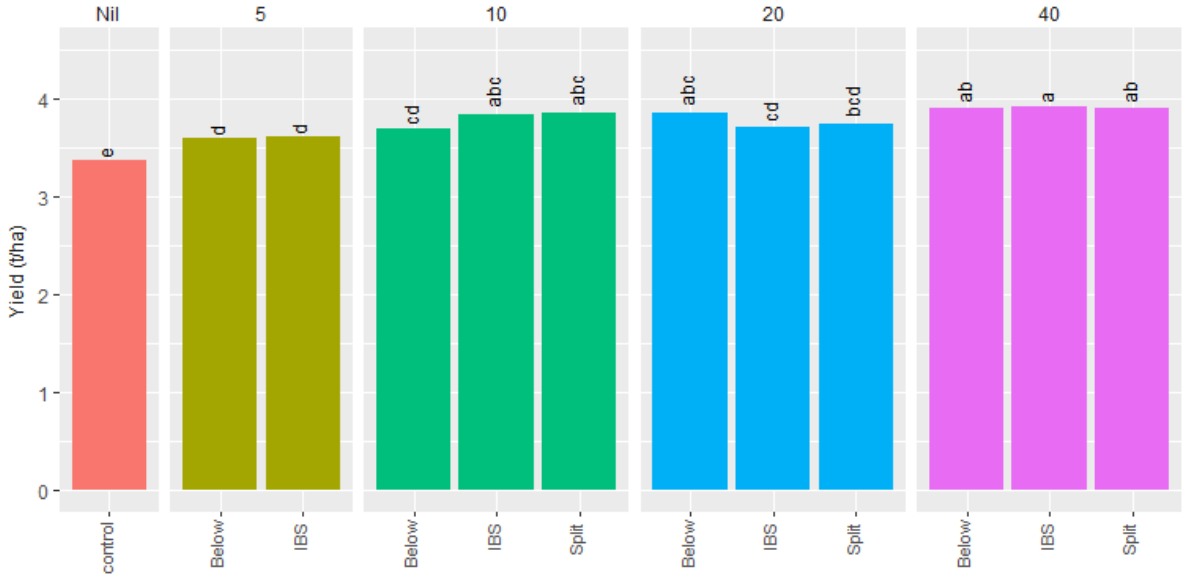

Figure 2: Canola yield (t/ha). Treatments with the same letter are not significantly different.

Grain quality

- The average protein content was 21.2%.
- The average oil content was 46.7%.
- Oil was slightly higher with low P application rates, but this was likely an indirect interaction between yield/seed number and oil rather than a direct effect of P rate.

Discussion

The 2024 Wallendbeen trial was sown after a pasture phase with high residual N and organic carbon levels. Combined with good fallow rainfall and optimum soil pH, yield potential was high with the only apparent yield limiting factor being the soil Colwell P level of 29 mg/kg, below the critical value of 41 mg/kg for canola production in the high rainfall zone[2].

This trial focused more on efficiency, rather than the safety of P application methods. There was no difference between P rate or placement on canola establishment. Previous P placement trials have shown the importance of separating P and the canola seed; this distance does not need to be great with ~1 cm in this trial being adequate.

Applying all P on the surface and incorporated by sowing (IBS) reduced early vigour (measured by NDVI), but possibly only delayed rather than reduced the overall uptake of P. The yield was similar to treatments where P was applied Below seed or Split (5 kg/ha Below seed, the balance IBS). Applying some P Below seed (5 kg/ha) or

[2] Microsoft Word - 2019ASA_McCaskill_#329.docx
https://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_McCaskill_329.pdf

in the furrow with seed (not included in trial) could be a useful option to minimise negative effects of P, while providing adequate P nutrition.

There is no evidence to support broadcasting P in other crops except canola. Canola appears to have an exceptional ability to scavenge surface nutrients that other crops don't have.

Conclusions

- Applying some P in-furrow and the balance of P broadcast and incorporated by sowing is a good strategy for growers wanting to:
  - minimise the negative effects of P on canola establishment (especially in disc seeding and single boot tine systems)
  - enhance efficiency of sowing operations, reducing the fertiliser refill requirement.
- Broadcasting P (either in the IBS or Split treatments) did reduce early vigour, but crops compensated and final yields were not different.
- In this trial where treatments did not impact establishment, P rate was more important than P placement.

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Appendix

Results

Table 5: Results - in crop and harvest observations

Phosphorous		Vegetation index						Yield		Oil	
Placement	Rate (kg/ha)	(39 DAS)		(47 DAS)		(56 DAS)		(t/ha)		(%)	
control		0.28	f	0.53	e	0.68	f	3.37	e	47.06	a
Below	5	0.38	cd	0.62	bcd	0.74	c	3.60	d	47.13	a
	10	0.43	a	0.69	a	0.77	a	3.69	cd	46.86	abc
	20	0.43	a	0.68	a	0.77	a	3.86	abc	46.65	bcde
	40	0.42	ab	0.67	ab	0.76	ab	3.91	ab	46.13	f
IBS	5	0.30	f	0.58	de	0.69	e	3.61	d	46.86	abc
	10	0.31	ef	0.59	d	0.71	d	3.85	abc	46.91	abc
	20	0.34	de	0.60	cd	0.72	d	3.71	cd	46.61	cde
	40	0.37	cd	0.64	abc	0.76	ab	3.93	a	46.43	def
Split	10	0.38	bcd	0.67	ab	0.75	bc	3.86	abc	46.93	ab
	20	0.38	cd	0.66	ab	0.75	abc	3.74	bcd	46.71	bcd
	40	0.41	abc	0.68	a	0.76	ab	3.91	ab	46.38	ef
		0.04		0.05		0.02		0.18		0.31	