GOA trial site report

Canola - fine tuning phosphorus management.

Grain Orana Alliance

Trial code:	GANU02624-1
Season/year:	Winter 2024
Farm name and Location:	"Wynona", Ballimore
Farm owner	Warren Barden
Grower	Nathan Simpson

Keywords

GANU026, phosphorus, establishment, canola.

Take home messages

- Starter fertiliser placed with the seed at rates of 10 kg phosphorus (P)/ha or more can reduce canola establishment.
  - Canola can compensate; reduced establishments do not always result in lower yields
  - Lower establishments do reduce crop competitiveness early in the season, and may require additional weed control measures
- Canola can recover P applied to the soil surface provided some surface soil moisture is present.
- Split P applications (e.g. 5 kg P/ha with seed + remainder incorporated by sowing (IBS) or top-dressed) reduce risk to establishment, while maintaining crop competition, yield, and grain quality.
- Splitting P applications affords growers greater sowing efficiency and the flexibility to respond to seasonal developments and risk.

Background

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

Some key findings from the previous trials include:

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

More recently, GOA has focused on evaluating the effects of split P applications i.e. applying a small, safe amount with the seed as starter P fertiliser to help establishment and early vigour, and applying the remaining P required either IBS, spread on the soil surface, or top-dressed (TD) 4-8 weeks after sowing.

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 in this space and give growers the confidence to apply the required P for maximal yield potential in such a way that reduces risk to establishment and increases flexibility of P applications.

Aims

To investigate whether splitting the application of P, both in application method and timing, can minimise establishment damage while maintaining yield.

Treatment descriptions

Key trial information is listed in Table 1

Table 1: Trial information

Activity	**Date**
Equipment	Knife point, press wheel
Row spacing	250 mm
Nitrogen fertiliser	200 L/ha UAN
Phosphorous fertiliser	As per treatment list
Crop and species	Canola (44Y94CL)

The Establishment treatments refer to the P placement and rates applied at sowing. Phosphorus treatments that were top dressed after sowing had no impact on establishment and were therefore classified as either nil or With5 in the establishment analysis. Treatments are listed in Table 2.

Note:

- all split treatments have 5 kg/ha P with the seed and the balance of the rate as per the placement description
- TD4wks = Top dressed 4 weeks post sowing (actual 48 days after sowing (DAS) ~ 7weeks)
- TD8Wks = Top dressed 8 weeks post sowing (actual 74 DAS ~ 10 weeks).

Table 2: Phosphorus application timing, placement, and rate (kg/ha). Establishment treatments reflect those where P influenced establishment (P top dressed in crop had no influence over establishment).

Timing	Placement	Rate	Establishment treatments
Control	Control	0	Control
TD4wks	TD	10	Control
TD4wks	TD	20	Control
TD8wks	TD	20	Control
Sowing-IBS	IBS	5	IBS5
Sowing-IBS	IBS	10	IBS10
Sowing-IBS	IBS	20	IBS20
Sowing-IBS	IBS	30	IBS30
Sowing-split IBS	Split - IBS	10	Split10
Sowing-split IBS	Split - IBS	20	Split20
Sowing-split TD	Split – top dressed	10	Split10
Sowing-TD4wks	Split – top dressed	10	With5
Sowing-TD8wks	Split – top dressed	10	With5
Sowing-split TD	Split - topdressed	20	Split20
Sowing-with	With	10	With10
Sowing-with	With	20	With20
Sowing-with	With	30	With30

Site Selection

This site was selected because it had a history of limited P applications and was thought to be P responsive. Subsequent soil (Table 3) testing revealed that the site had a Colwell P level of 28 mg/kg, which is above the

threshold level (25 mg/ka) required to achieve 95% of maximum grain yield[1]. The site had an acid band in the 10-30 cm layer with a pH of 4.9 and an aluminium saturation of 14%, which is at a level that can limit canola production[2].

Table 3: Soil test results (IPL).

Analyte	Units	0-10	10-30	30-60	60-90	90-120	Total
pH (1:5 CaCl2)		6.1	4.9	6.1	7.1	7.0	-
Nitrate nitrogen	mg/kg	23.0	14.0	11.0	5.4	4.0	-
Ammonium nitrogen	mg/kg	2.5	1.1	1.0	0.8	-	-
Available nitrogen	kg/ha	36	42	50	26	16.8	171
Phosphorus (Colwell)	mg/kg	28	8.0	7.6	<5.0	6.8	-
Aluminium saturation	%	6.0	14	3.4	<1	3.2	-

Rainfall

The 2024 season was a relatively wet year, the in-crop rainfall was approximately 273.6 mm, which was aided by considerable stored fallow soil moisture accumulated over the 2023/2024 summer (Table 4).

Table 4: Monthly rainfall[3] (mm) and long-term average (LTA) at trial site

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2024	78	63	45	74	41	56	54	57	14	46	108	74	**710**
LTA	61	51	52	41	42	46	46	43	42	56	57	52	**589**

Results

Plant establishment

- The average trial establishment was 54% (Figure 1), the lowest establishment was in the With30 treatment at 18%, and the highest establishment was the Control treatment with 62%.
- Rates of 10 kg/ha P and above With the seed decreased establishment compared with the Control.

[1] https://grdc.com.au/__data/assets/pdf_file/0019/395020/Paper-Sandral-Graeme-Phosphorus-after-dry-seasons-March-Update-2020.pdf

[2] Critical nutrient levels for canola in Western Australia | Agriculture and Food, https://www.agric.wa.gov.au/soil-nutrients/critical-nutrient-levels-canola-western-australia?page=0%2C3#smartpaging_toc_p3_s1_h3

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

- There was no difference in establishment between the control, 5 kg/ha With, both Split rates, and the 20 and 30 kg/ha IBS rates.

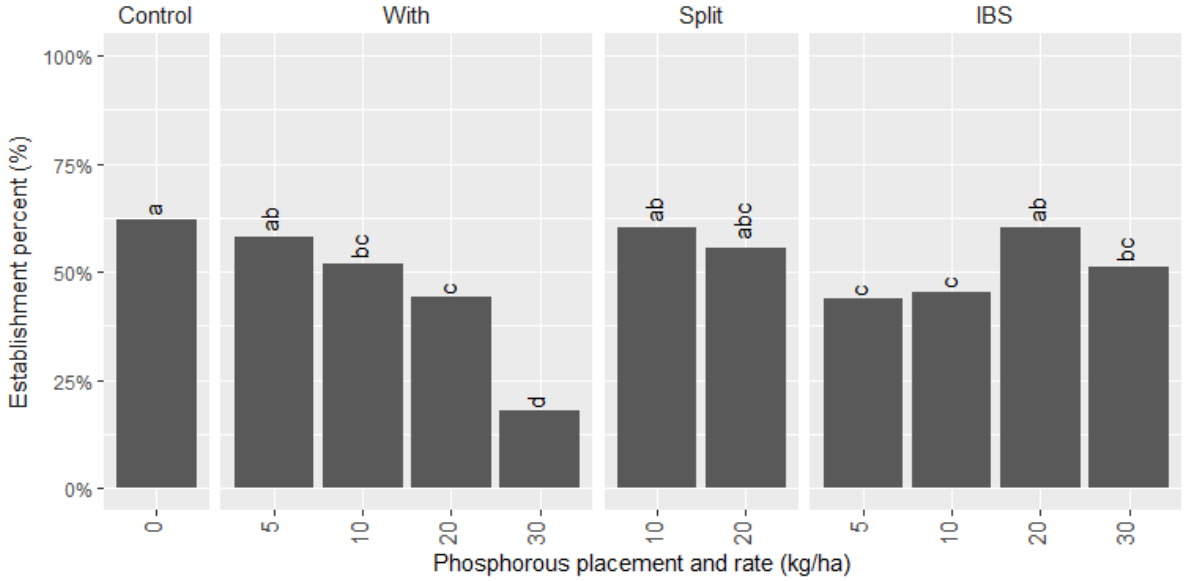

Figure 1: Plant establishment.

Vegetation index

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

Vegetation index (VI) was measured at 48, 66 and 74 days after sowing (DAS) (Figure 2) to coincide with the topdressing treatments.

NDVI 48DAS (assessed prior to in-crop topdressing treatments):

- With30 had lowest VI
- TD4wks (both rates) and the control treatment was also low.
- application of 5 kg/ha with the seed (With and Split) had a higher VI than the same rate placed away from the seed (IBS or delayed)
- 30 kg P/ha IBS had a similar VI to 5 kg P/ha placed with the seed.

NDVI 74DAS:

- Higher rates applied at sowing had the highest VI, exception is the With treatment, where the highest rate had the lowest VI
- Delayed treatments were not different to the control

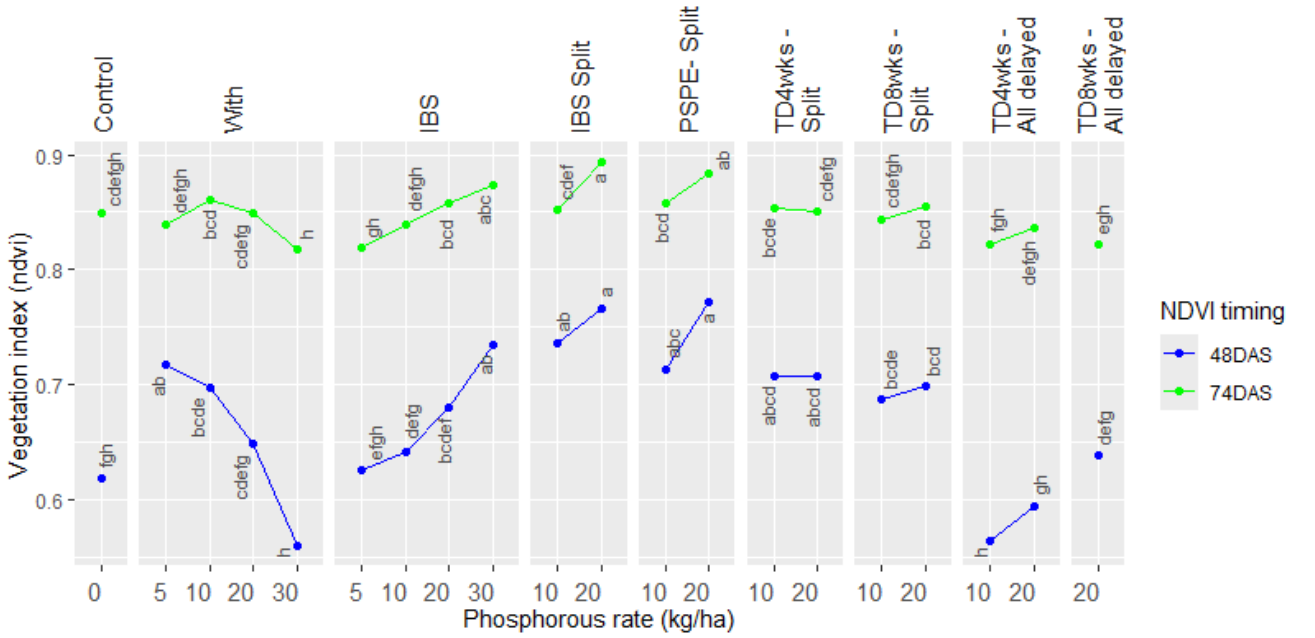

Figure 2: Vegetation index assessed 48, and 74DAS.

Grain yield

- The lowest yield was in the Control with 1.43 t/ha (Figure 3).
- The highest yield was in the IBS30 with 2.76 t/ha.
- There was a positive response to P. All treatments that received 20 kg/ha P had a higher yield than where 5 kg/ha P was applied, and both treatments that had 5 kg/ha P applied had a higher yield than the control.
- Where 10 kg/ha P was applied, there was no difference in yield between the various placements/timings.
- Where 20 kg/ha P was applied, none of the alternative P placement options wire diffident to the With treatment.

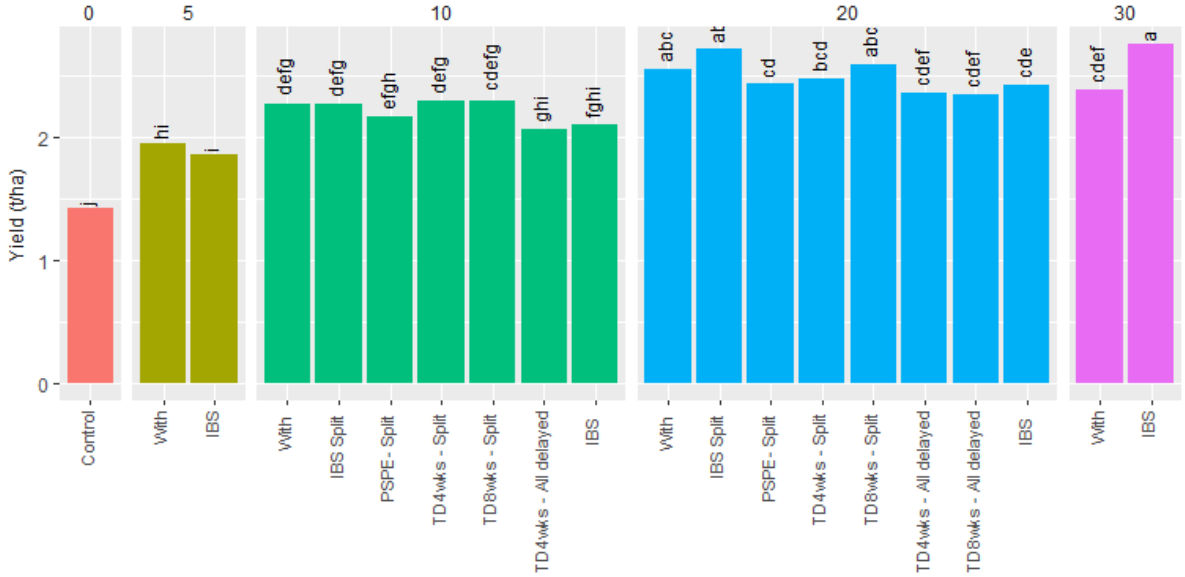

Figure 3: Canola yield (t/ha)

Grain quality:

- There were inconsequential treatment effects on oil content.
- Average oil content across the site was 44.3% (Table 5).

Discussion

The 2024 season provided favorable conditions for canola growth, with above-average rainfall and adequate soil moisture. Despite underlying soil acidity and elevated aluminium levels, the trial achieved an average yield of ~2.3 t/h and an average oil content of ~44.3%. The trial demonstrated a strong yield response to P, with up to 65% (1.33 t/ha) yield improvement between the lowest and highest performing treatments.

The trial confirmed that placing high rates of P (30 kg/ha as MAP) directly with the seed significantly reduced plant establishment, with the lowest recorded at just 18%. The lower P rates (5 kg/ha) and split applications, where only 5 kg/ha was placed with the seed and the remainder applied via IBS or topdressing, had no negative effect on establishment.

Surface-applied P, including delayed topdressing at 4 and 8 weeks after sowing, was effective in maintaining crop vigor and yield. This was likely due to strong surface root development and sustained soil moisture, which allowed the crop to access nutrients from the soil surface. NDVI measurements showed that even treatments with delayed P application recovered well and matched the vigour of other treatments over time. Interestingly, while the With30 treatment had poor early establishment, its NDVI values later in the season were similar to other treatments, demonstrating canola's ability to compensate for low plant populations. However, reduced early growth may increase weed pressure and reliance on herbicides.

Overall, split applications proved to be a practical strategy for maintaining yield while reducing establishment risk by reducing fertiliser in contact with the seed at sowing, especially in conditions where deep banding is not feasible. However, these techniques should not be used as a justification to reduce canola seeding rates until

other factors influencing establishment, such as stubble loading, press wheel pressure, etc, are better understood.

Conclusions

- Placement of starter fertiliser with the seed at rates of 10 kg P/ha and above can reduce establishment.
- Splitting P applications is an option to maintain full P rates, while reducing the risk to establishment.
- Splitting P applications has no negative effect on crop competition, yield, and grain quality, in the conditions tested.
- Splitting P applications affords growers greater sowing efficiency and the flexibility to respond to seasonal developments and risk.

Acknowledgements

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DISCLAIMER — TECHNICAL

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Appendix

Results

Table 5: Results - in crop and harvest observations.

Phosphorous		Vegetation index						Yield		Oil	
Placement	Rate (kg/ha)	(48 DAS)		(66 DAS)		(74 DAS)		(t/ha)		(%)	
Control	0	0.62	fgh	0.83	ghij	0.85	cdefgh	1.43	j	43.87	bc
With	5	0.72	ab	0.87	abcdef	0.84	defgh	1.95	hi	44.40	abc
	10	0.70	bcde	0.88	abcde	0.86	bcd	2.27	defg	44.22	abc
	20	0.65	cdefg	0.87	abcdef	0.85	cdefg	2.56	abc	44.02	abc
	30	0.56	h	0.81	j	0.82	h	2.39	cdef	44.17	abc
IBS Split	10	0.74	ab	0.89	ab	0.85	cdef	2.27	defg	44.43	abc
	20	0.77	a	0.89	a	0.89	a	2.72	ab	44.18	abc
PSPE-Split	10	0.71	abc	0.87	abcdef	0.86	bcd	2.17	efgh	44.70	a
	20	0.77	a	0.89	a	0.88	ab	2.44	cd	44.12	abc
TD4wks - Split	10	0.71	abcd	0.86	defg	0.85	bcde	2.29	defg	44.32	abc
	20	0.71	abcd	0.89	abc	0.85	cdefg	2.48	bcd	44.65	ab
TD8wks - Split	10	0.69	bcde	0.86	bcdefg	0.84	cdefgh	2.30	cdefg	44.72	a
	20	0.70	bcd	0.87	abcdef	0.85	bcd	2.59	abc	43.80	c
TD4wks - All delayed	10	0.56	h	0.82	ij	0.82	fgh	2.07	ghi	44.15	abc
	20	0.59	gh	0.84	fghi	0.84	defgh	2.36	cdef	44.35	abc
TD8wks - All delayed	20	0.64	defg	0.83	hij	0.82	egh	2.35	cdef	44.25	abc
IBS	5	0.63	efgh	0.85	efgh	0.82	gh	1.87	i	44.25	abc
	10	0.64	defg	0.86	cdefgh	0.84	defgh	2.11	fghi	44.15	abc
	20	0.68	bcdef	0.85	defgh	0.86	bcd	2.42	cde	44.25	abc
	30	0.73	ab	0.88	abcd	0.87	abc	2.76	a	44.27	abc
lsd	lsd	0.07		0.03		0.03		0.27		0.79	

Table 6: Results - plant establishment.

Phosphorous		Plant establishment			
Placement	Rate (kg/ha)	(plants/m^2)		(%)	
Control	0	33.12	a	62	a
With	5	30.74	ab	58	ab
	10	27.55	bc	52	bc
	20	23.71	cd	44	c
	30	9.49	e	18	d
Split	10	31.72	ab	60	ab
	20	29.27	abc	56	abc
IBS	5	19.66	d	44	c
	10	23.82	cd	45	c
	20	31.90	ab	60	ab
	30	27.23	bc	51	bc
lsd		3.49		12	