GOA trial site report

Canola: fine tuning phosphorus management.

Grain Orana Alliance

Trial code:	GANU02624-2
Season/year:	Winter 2024
Farm name and location:	"Coradgery", North Parkes
Farm owner:	Edwin Nash
Grower:	Nathan Border

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 significantly reduce canola establishment.
- Split P applications (e.g. 5 kg P/ha with seed + remainder immediately before sowing (IBS) or top-dressed), reduce establishment risk while maintaining crop competition, yield, and grain quality.
- Despite poor establishment when high rates of fertiliser were applied with the seed, canola can compensate for vigor and yield throughout the season. However, lower plant populations are likely to induce high weed pressures and herbicide reliance early in the crop.
- Splitting P applications affords growers greater sowing efficiency and the flexibility to respond to the seasonal and risk.
- Canola can effectively recover soil surface applied P, provided there is some surface soil moisture.

Background

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

Some of the key findings to date 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; that is, 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 incorporated by sowing (IBS), spread on the soil surface, or top-dressed 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	120 L/ha UAN
Phosphorous fertiliser	As per treatment list
Crop/species	Canola (44Y94)

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 = Topdressed (TD) planned for 4 weeks post-sowing (actual 49 days after sowing (DAS) ~ 7 weeks)
- TD8Wks = TD planned for 8 weeks post-sowing (actual 65 DAS ~ 9 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
4wks	TD	10	Control
4wks	TD	20	Control
8wks	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 –TD	10	Split10
Sowing-TD4wks	Split – TD	10	With5
Sowing-TD8wks	Split – TD	10	With5
Sowing-split TD	Split – TD	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 showed that the site had a Colwell P level of 35 mg/kg, which is above the level (25 mg/ka) required to achieve 95% of maximum grain yield[1].

Testing also revealed that the site had moderate-high levels of salinity and sodicity, particularly below 30 cm, which may limit canola yields.

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

Table 3: Soil test results (IPL)

Analyte	Units	0-10 cm	10-30 cm	30-60 cm	60-90 cm	90-120 cm	Total
pH (1:5 CaCl2)		5.0	7.7	8.4	8.1	7.8	-
Nitrate N	mg/kg	49.0	18.0	12.0	3.6	3.9	-
Ammonium N	mg/kg	39.0	6.5	1.4	1.1	1.2	-
Available N	kg/ha	123	69	56	20	-49.98	268
Phosphorus (Colwell)	mg/kg	35	6.6	<5.0	<5.0	<5.0	-
Aluminium saturation	%	0.79	<1	<1	<1	<1	-
EC Sat. Ext.	dS/m	0.9	2.9	4.3	14.8	19.8	-
ESP	%	8.6	16	15	19	15	-

Rainfall

The 2024 season was relatively wet, with the in-crop rainfall was ~314.1 mm, which added to the considerable soil moisture accumulated in the fallow period 2023/2024 (Table 4).

Table 4: Monthly rainfall[2] (mm) and long-term average (LTA) at trial site

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2024	106	41	20	63	70	72	44	58	16	44	75	108	**717**
LTA	53	50	46	41	42	45	41	42	36	46	53	48	**543**

Results

Plant establishment

- Average establishment in the trial was 44% (Figure 1), the lowest establishment of 16% was in the With20 treatment, and the highest was the IBS at 61%.
- All P rates treatment With the seed decreased establishment compared to the control.
- There was no difference in establishment between the control, split20, and all IBS and PSPE treatments.

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

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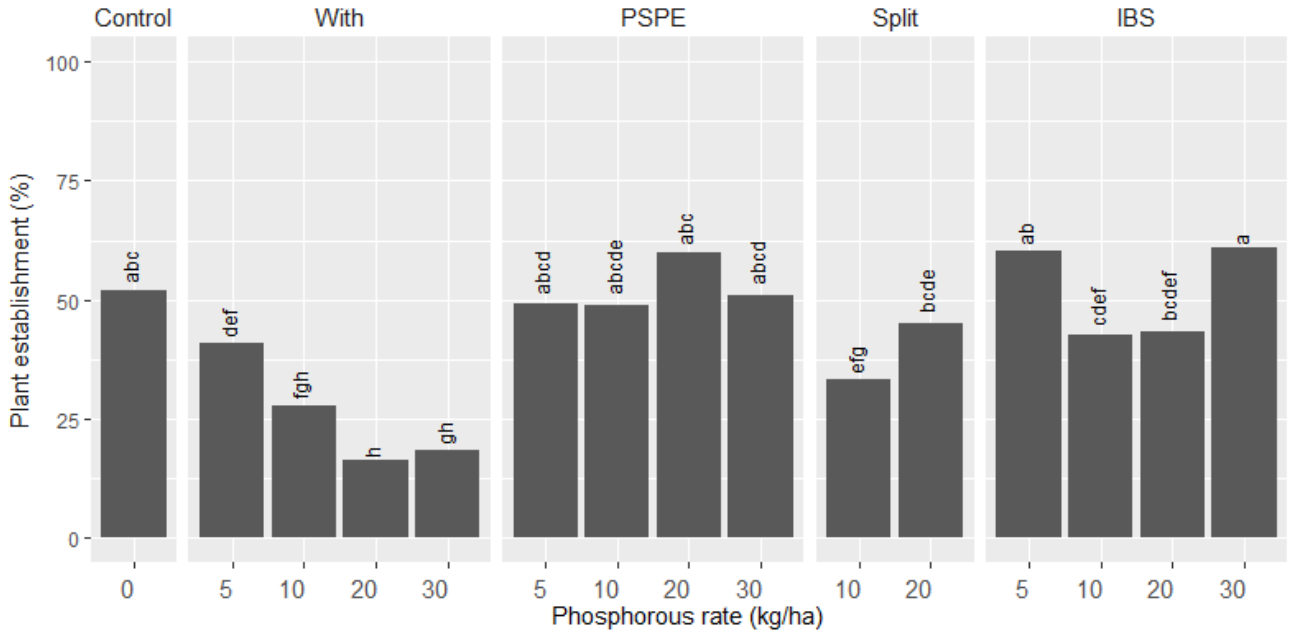

Figure 1: Plant establishment.

Vegetation index

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

- Vegetation index (VI) was measured at 49, 65 and 80 days after sowing (DAS) (Figure 2), coinciding with the topdressing treatments.

NDVI 49DAS (assessed immediately prior to the first in-crop topdressing treatment):

- The With30, With20 and the control treatments had lowest VI.

NDVI 65DAS and 80DAS:

- With30 had lowest VI, and the remining With and control treatments were also low.
- The remaining treatments had similar VI measurements.

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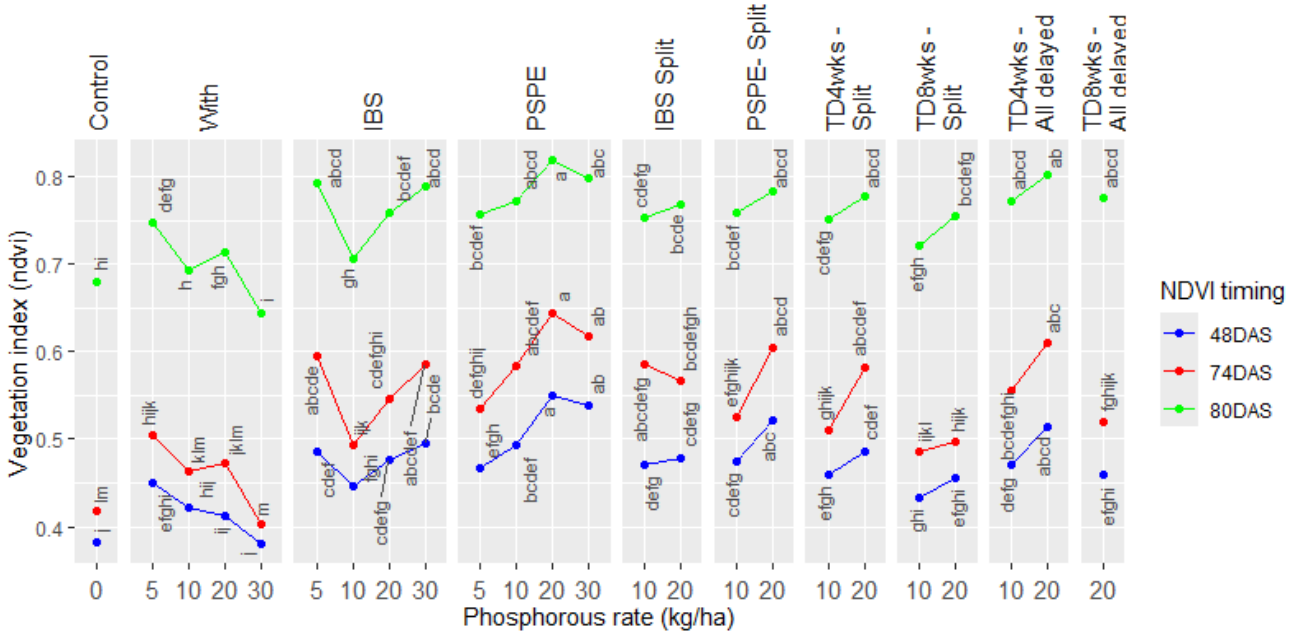

Figure 2: Vegetation index assessed 49, 65, and 80DAS.

Grain yield

- The lowest yield was in the Control with 1.92 t/ha (Figure 3).
- The highest yield was 2.29 t/ha.
- There was a positive response to P. Most treatments that received 5 kg/ha or more P had a higher yield than the control.
- Nearly all treatments that received 5 kg/ha P pr greater achieved the same yield as the site maximum; however, IBS5 and With20 had reduced yields.

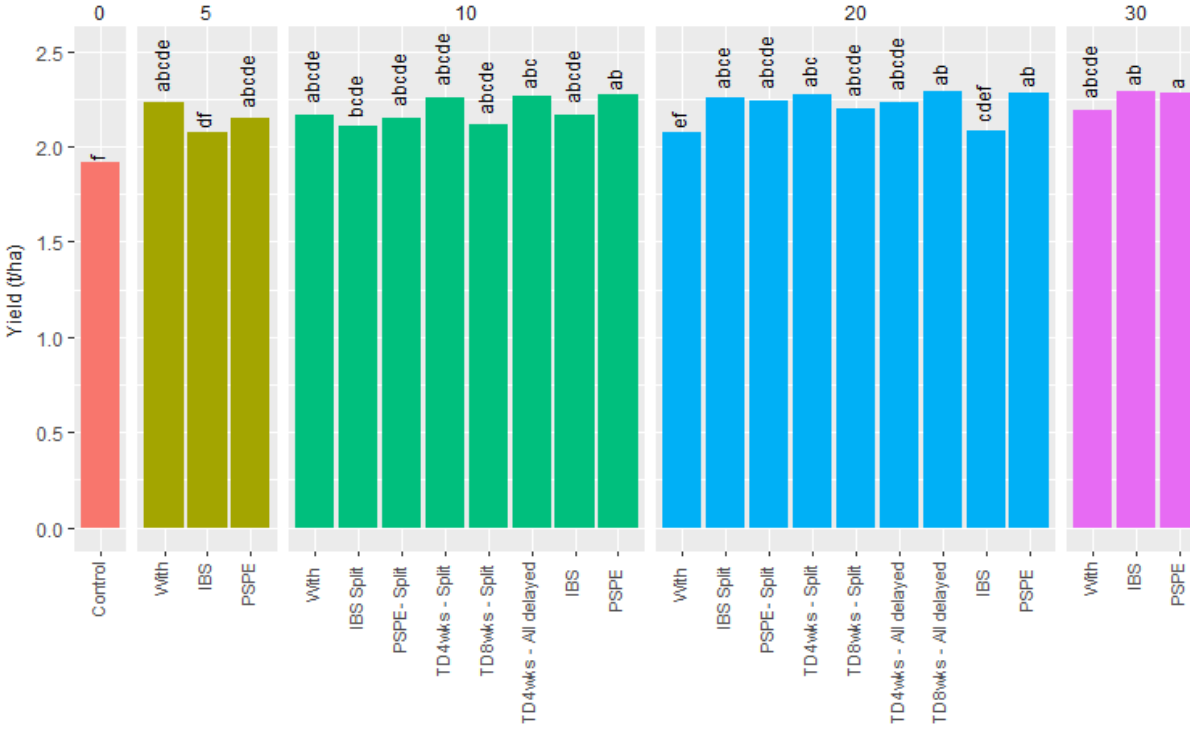

Figure 3: Canola yield (t/ha)

Grain quality

- Average protein content across the site was 21.8% (data not shown).
- Average oil content across the site was 43.4% (Table 5).

Discussion

The 2024 season provided favourable conditions for canola growth, with above-average rainfall and adequate soil moisture. Despite underlying soil salinity and sodicity, the trial achieved an average yield of ~ 2.2 t/h and an average oil content of ~ 43.4%. The trial demonstrated a yield response to P, with up to 65% (0.37 t/ha) yield improvement between the lowest and highest performing treatments.

The trial confirmed that placing high rates of phosphorus (30 kg/ha as MAP) directly with the seed significantly reduced plant establishment, with the lowest recorded at just 16%. In contrast, lower 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 a reduced impact or no negative effect on establishment.

Surface-applied P, including delayed topdressing at 4 and 8 weeks after sowing, was effective in maintaining crop vigour and yield. This was likely due to strong surface root development and sustained soil moisture, allowing the crop to access nutrients from the soil surface. The NDVI measurements showed that even treatments with delayed P application recovered well and matched the vigour of other treatments over time. While it's been demonstrated in other GOA trials that canola can compensate in biomass over time despite poor

establishment, the prolonged low NDVI measurements in the With30 treatment indicates that there is a limit to this ability, which 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 establishment risk.
- 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.

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Appendix

Results

Table 5: Results - in crop and harvest observations

Phosphorous		Vegetation index						Yield		Oil	
Placement	Rate (kg/ha)	(49 DAS)		(65 DAS)		(80 DAS)		(t/ha)		(%)	
Control	0	0.40	i	0.45	hi	0.71	gh	1.92	f	43.22	abcdef
With	5	0.46	efgh	0.53	defg	0.76	bcdef	2.23	abcde	43.37	abcde
	10	0.43	hi	0.46	ghi	0.70	h	2.16	abcde	43.65	ab
	20	0.40	i	0.46	ghi	0.72	fgh	2.07	ef	43.50	abcd
	30	0.38	i	0.41	i	0.65	i	2.19	abcde	43.42	abcde
IBS Split	10	0.47	defg	0.55	bcdef	0.76	bcdef	2.11	bcde	43.50	abcd
	20	0.51	abcd	0.58	abcde	0.77	abcde	2.26	abce	43.37	abcde
PSPE- Split	10	0.46	efgh	0.54	bcdef	0.74	efg	2.15	abcde	43.57	abc
	20	0.52	abc	0.61	abc	0.80	ab	2.24	abcde	43.72	a
TD4wks - Split	10	0.47	defgh	0.53	defg	0.76	bcde	2.26	abcde	43.40	abcde
	20	0.48	defg	0.56	abcdef	0.76	bcdef	2.27	abc	43.57	abc
TD8wks - Split	10	0.45	efgh	0.50	fgh	0.73	efgh	2.11	abcde	43.00	cdef
	20	0.45	gh	0.50	fgh	0.75	defg	2.20	abcde	43.22	abcdef
TD4wks - All delayed	10	0.47	defgh	0.54	cdef	0.76	abcde	2.26	abc	42.75	f
	20	0.50	bcdef	0.59	abcd	0.79	abc	2.23	abcde	43.35	abcdef
TD8wks - All delayed	20	0.46	efgh	0.52	efgh	0.77	abcde	2.29	ab	42.85	ef
IBS	5	0.48	cdefg	0.56	abcdef	0.77	abcde	2.08	df	43.70	a
	10	0.45	fgh	0.50	fgh	0.72	fgh	2.17	abcde	43.50	abcd
	20	0.47	defg	0.54	def	0.75	cdef	2.08	cdef	43.73	a
	30	0.49	cdefg	0.57	abcdef	0.78	abcde	2.29	ab	43.33	abcdef
PSPE	5	0.48	defg	0.55	bcdef	0.77	abcde	2.15	abcde	43.07	bcdef
	10	0.50	abcde	0.59	abcde	0.78	abcde	2.27	ab	43.47	abcd
	20	0.54	a	0.63	a	0.81	a	2.28	ab	43.30	abcdef
	30	0.53	ab	0.61	ab	0.79	abcd	2.28	a	42.90	def
lsd	lsd	0.04		0.07		0.04		0.19		0.60	

Table 6: Results - plant establishment

Phosphorous		Plant establishment			
Placement	Rate(kg/ha)	(plants/m2)		(%)	
Control	0	27.45	abc	52	abc
With	5	21.58	def	41	def
	10	14.79	fgh	28	fgh
	20	8.68	h	16	h
	30	9.72	gh	18	gh
Split	10	17.62	efg	33	efg
	20	23.91	bcde	45	bcde
IBS	5	31.93	ab	60	ab
	10	22.56	cdef	43	cdef
	20	22.84	bcdef	43	bcdef
	30	32.18	a	61	a
PSPE	5	26.00	abcd	49	abcd
	10	25.79	abcde	49	abcde
	20	31.74	abc	60	abc
	30	27.00	abcd	51	abcd
lsd		4.58		16	