

## Canola - fine tuning phosphorus management

Grain Orana Alliance

<b>Trial code:</b>	GANU02623-1
<b>Season/year:</b>	Winter 2023
<b>Location:</b>	Keenans, Wongarbon
<b>Trial partners:</b>	Maurie Street
<b>Trial establishment date:</b>	22/04/2023

### Keywords

GANU026, phosphorus, establishment, canola.

### Take home messages

- Placement of phosphorus (P) at rates of 10 kg/ha with the seed on a 250 mm row spacing (10 inch) can reduce canola establishment.
- Canola roots can access fertiliser placed on the soil surface.
- Canola roots can access starter fertilizer spread on the soil surface, even when delayed by 8 weeks post sowing,
- Growers should consider splitting the P application to improve both canola establishment and sowing efficiencies.
- Canola yields increase by more than 55% with the addition of 5 kg/ha of P at this P responsive site.
- The treatments where P was delayed and top dressed in-crop had similar yields to the treatments with 5 kg/ha of P at sowing.

### Background

Grain Orana Alliance (GOA) has been investigating options to reduce the negative impact of starter fertiliser on canola establishment conducting more than 24 trials over the past 7 years.

A summary of the key findings:

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- canola establishment can be affected by rates as low as 10 kg/ha P or ~50 kg mono ammonium phosphate (MAP)
- placement of fertiliser under the seed (deep banding) with greater than 2 cm of separation will eliminate most of establishment damage, except at very high rates in some circumstances
- placement of P on the soil surface (either prior to sowing or broadcast post-sowing) eliminated crop damage and in most trials with no yield reduction
- where yield loss did occur due to this placement method, the season was generally drier with potentially less root activity on the soil surface.

GOA aims to investigate split and delayed P applications as an alternative placement option. This is when a smaller portion of the starter fertiliser is placed with the seed and the remainder applied to the soil surface either at sowing or post sowing.

- Lower fertilizer quantities at sowing should maximise emergence and will increase machinery efficiency (with less refilling time of the seeder).
- The application of surface applied fertiliser could be delayed, especially where establishment is more risky (dry sowing or sowing into marginal moisture).
- Develop options for growers who do not have the machinery to deep band fertilizer.

## Aims

To investigate whether splitting P applications in canola can minimise establishment damage while maintaining yields, particularly in dry years. Split P applications to include timing, rates, and placement options.

## Treatment descriptions

Key dates and timings are listed in Table 1

Table 1: Key dates

Activity	Date
Sowing	22/04/2023
Harvest	13/11/2023
Topdressing and ndvi (38 DAS)	30/05/2023
Topdressing and ndvi (69 DAS)	22/06/2023
Ndvi (111 DAS)	11/08/2023

Treatments are listed in Table 2. Note: when the establishment assessments were conducted, treatments that included a delayed application had not received the full rate of starter fertiliser, i.e. P applied 38 and 69 days

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after sowing (DAS) and were assessed as 'nil while the Split-topdressed treatments had received the same amount as the 'With5 treatments.

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

Timing	Placement	Rate	(Establishment treatments)
Control	Nil	0	Nil
Sowing	With	5	With 5
Sowing	With	15	With 10
Sowing	With	30	With30
Sowing	Split - IBS	15	With5 + IBS10
Sowing	Split - IBS	30	With5 + IBS25
Sowing	Split - topdressed	15	With5 + TD15
Sowing	Split - topdressed	30	With5 + TD25
Sowing-38 DAS	Split - topdressed	15	With5
Sowing-38 DAS	Split - topdressed	30	With5
Sowing-69 DAS	Split - topdressed	15	With5
Sowing-69 DAS	Split - topdressed	30	With5
38DAS	Topdressed	15	Nil
69DAS	Topdressed	15	Nil

**Site Selection:** This site came out of a degraded pasture and with limited P applications and was selected due to its low P history. Subsequent soil (Table 3) testing showed the site was very low in P at 16.0 mg/kg and was tending towards being acidic with a pH of 4.4 combined with elevated aluminum 6.3%.

Table 3: Soil test results (IPL)

Analyte	Units	0-10	10-30	30-60	60-90	Total
pH (1:5 CaCl2)		4.4	4.5	7.2	8.4	
Nitrate nitrogen	mg/kg	78.0	19.0	8.8	4.8	
Ammonium nitrogen	mg/kg	9.7	1.7	3.2	1.4	
Available nitrogen	kg/ha	123	58	50	26	257
Phosphorus (Colwell)	mg/kg	16.0	6.0	<5	<5	
Aluminium saturation	%	6.3	3.9	0.5	<1.0	

**Rainfall:** 2023 was a relatively dry season, the in-crop rainfall was approximately 196.6 mm, however there was considerable soil moisture left over from 2022 (Table 4).

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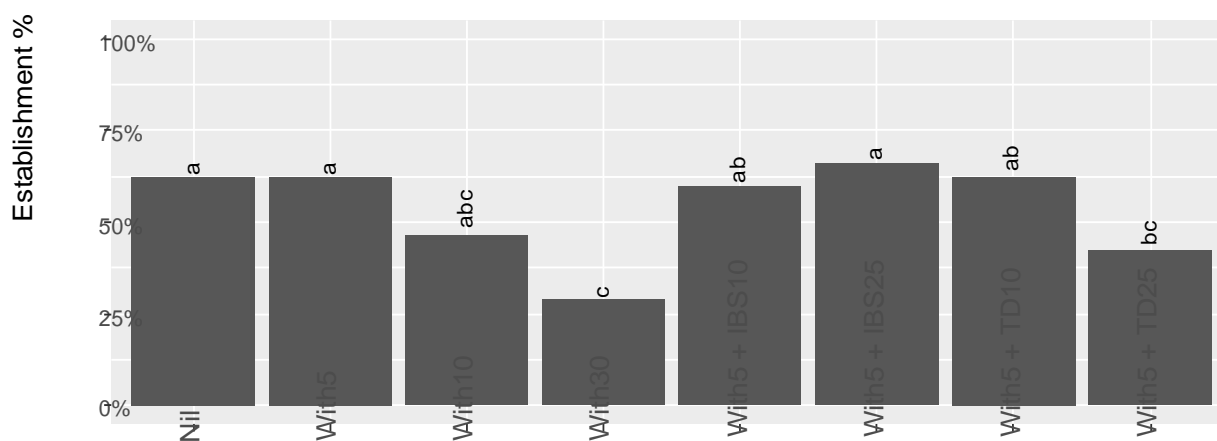
Table 4: Monthly rainfall<sup>1</sup> (mm) and long-term average (LTA) at trial site

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2022	100	20	99	156	70	14	71	116	93	172	68	10	989
2023	64	30	22	38	6	44	34	14	5	34	90	50	431
LTA	60	51	52	42	42	45	45	42	41	55	54	51	580

## Results

### Plant establishment:

- Average establishment in the trial was 58% (*Figure 1*)
- There was no difference in establishment between the Nil, With 5, With5 + IBS10, With 5 + IBS25, With 5 + TD 10
- The With 30 and the With5 + TD25 treatment had a lower establishment than the Nil.



Phosphorous placement and rate (kg/ha)

Figure 1: Plant establishment. Treatments with the same letter are not significantly different.

### Vegetation index:

<sup>1</sup> Gridded data for the trial site from: Access Gridded Data | LongPaddock | Queensland Government

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Vegetation index (VI) (a measurement of vegetation density) assessed 38, 69 and 111 DAS (Figure 2) to coincide with the topdressing treatments. A later measurement was taken to determine the impact of delaying P applications on crop recovery.

## NDVI 38DAS

- Lowest readings were where no P had been applied to date, i.e. nil, 38 DAS TD and 69 DAS TD.
- The With 30 treatment had lower VI than all the split treatments, except the 38 DAS TD- Split30.

## NDVI 69DAS

- Lowest readings where no P applied at that time, i.e. nil and 69 DAS TD
- 38 DAS TD higher VI than 69 DAS TD.
- The Split 30 TD at sowing had the highest VI

## NDVI 111DAS

- The lowest levels were for the nil P treatment
- The With 5, With 15, and 69 DAS TD treatments had a lower VI than 0DAS TD- Split30, which had the highest VI reading.

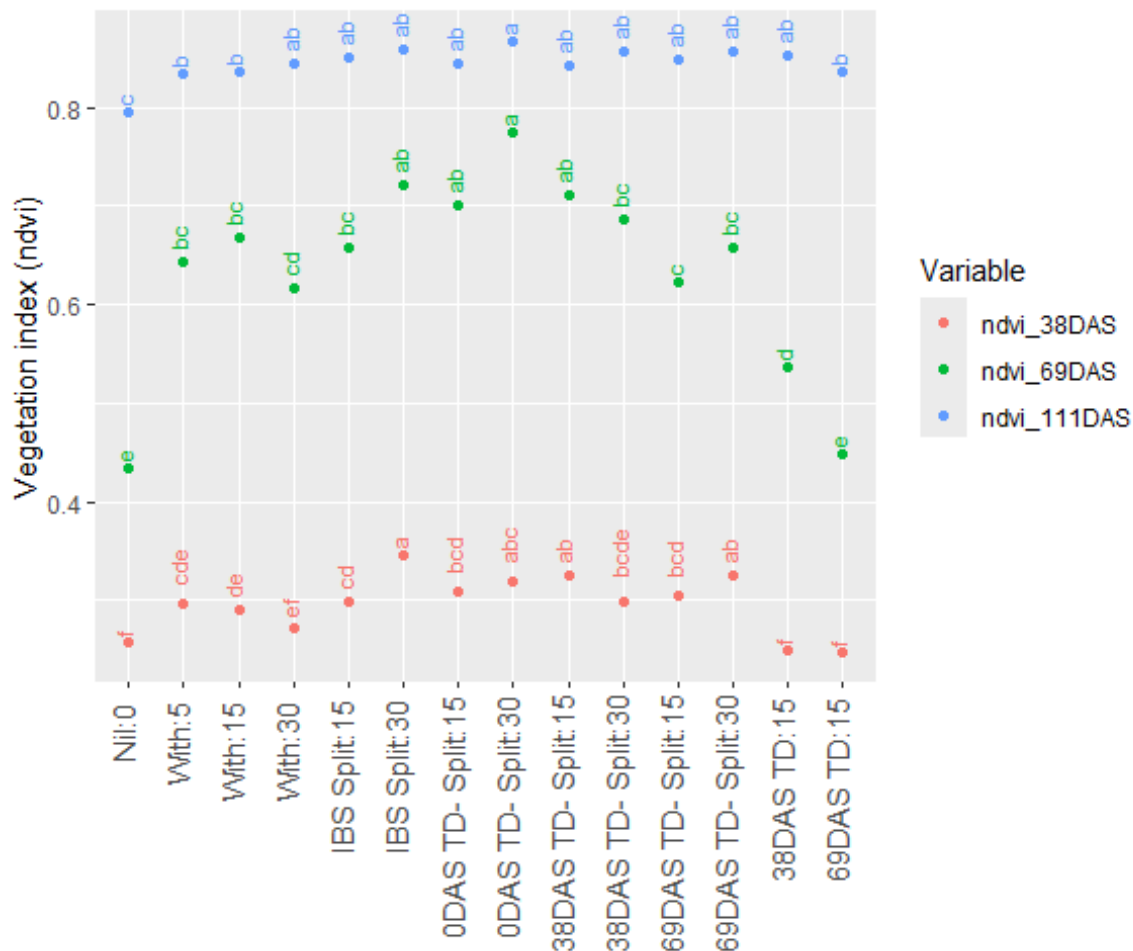


Figure 2: Vegetation index assessed 38, 69, and 111 DAS (30<sup>th</sup> May, 30<sup>th</sup> June and 28<sup>th</sup> July 2023). Treatments with the same letter are not significantly different.

### Grain yield:

- Lowest yields were in the nil treatment (Figure 3).
- There was a response to P, all treatments yielded more than the Nil treatment.
- Highest yield was the 69 DAS TD- Split 30 with 1.3 t/ha.
- All treatments had a similar yield to the With 5 (except for 69 DAS TD- Split 30).

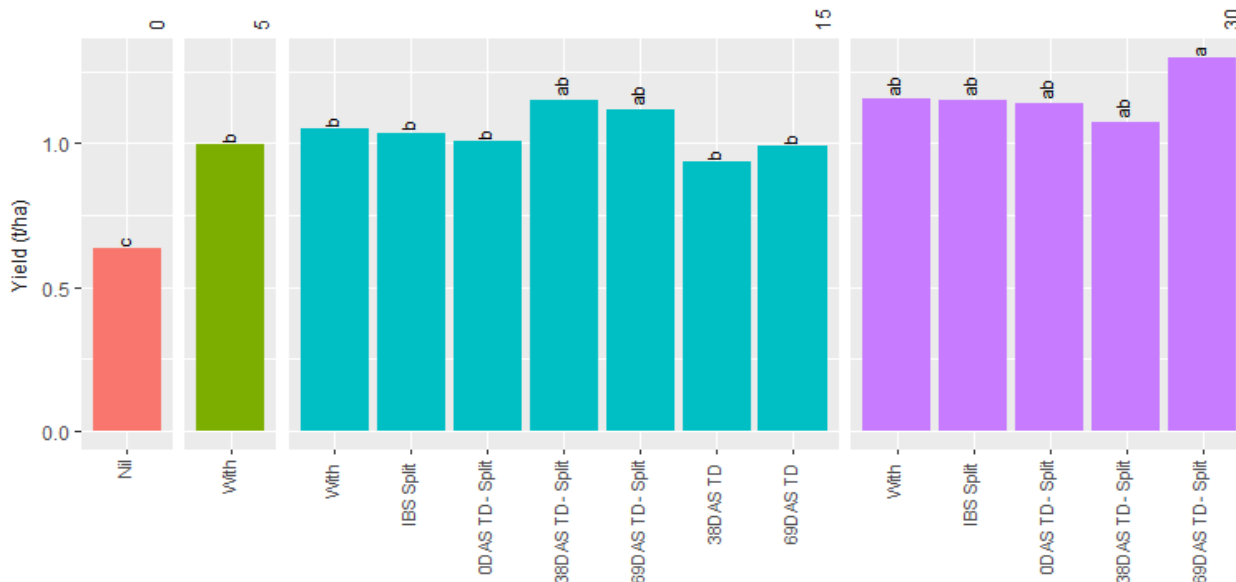


Figure 3: Canola yield (t/ha). Treatments with the same letter are not significantly different.

## Grain quality:

- Variations in oil content were driven by yield dilution (i.e. higher yields had lower oil content)
- Highest oil was Nil 0 at 41%
- The lowest oil was 38DAS TD- Split 30 at 39.3%.

## Discussion

The 2023 season had below average rainfall and the site was frosted. Despite this and underlying acidity in the paddock, the trial still managed an average yield of ~ 1.05 t/ha with oil at ~ 39.8%. There was a strong P response resulting in > 0.67 t/ha difference between the highest and lowest yielding treatments.

This trial confirmed that placement of 30 kg/ha P (as MAP) with the seed reduced establishment, justifying the work into alternative P placement.

The low rate of 5 kg/ha P did not affect establishment, neither did splitting the application prior to sowing (some with the seed, the remainder IBS). However, splitting the application and topdressing post sow (same day) reduced establishment, but only at the high P rate (30 kg/ha). The reason for establishment suppression seen in the top dressed, post sow treatment is unclear. However, ~30mm fell 7 days after sowing which may have coincided with emergence and it is plausible that there was some ammonia (canola is highly sensitive to this form of N) release from the N component of the MAP. During the process of post sow topdressing, the fertiliser can fall into the seed furrow and can be concentrated, potentially burning the emerging seedlings. But where P is spread prior to sowing (IBS), it is shifted away from the seed by the sowing action.

Moving P away from the seed should be considered as a tool to gain better establishment rather than one to reduce seeding rates until other issues (stubble, press pressure, etc) that could also affect germination are better understood.

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Measurements of the vegetation index (VI) demonstrated the P responsiveness of the site and the ability of canola to access fertiliser placed on the soil surface, shown in the delayed treatment results. Both delayed applications of top dressed P had significantly higher VI than the nil treatment when assessed a month or so post application. Observations under the crop canopy during the vegetative growth period revealed extensive root development very close to the soil surface, and at canopy closure the soil surface remained wet for extended periods of time. It is likely that these conditions allowed the surface roots to access P placed on the soil surface.

The VI also demonstrated the 'compensatory' ability of canola, although the With 30 had a much lower establishment, its VI was not different to other treatments after ~3 months. While canola can compensate, lower populations reduce the crops' ability to compete with weeds early in the growth period, adding pressure to herbicides and other weed control measures.

The site was P responsive; yields increase by more than 55% with the addition of 5 kg/ha. However, this was arguably enough to satisfy the crop demand in a relatively low yielding year and environment, as only one other treatment had a higher yield. The treatments where P was delayed and top dressed in crop had similar yields to the With 5, indicating that they were able to access sufficient P from the soil surface and enough time to optimise yield. It is not known whether 5 kg P/ha applied in a similar manner (all IBS or all TD) would have been sufficient.

## Conclusions

- Placement of starter fertiliser with the seed at rates of 10 kg P/ha and above can reduce establishment.
- Splitting P is an option to maintain application rates while reducing the establishment risk.
- Delayed, top dressed P applications had significantly higher VI than the nil P treatment.
- Canola can access P that is applied to the soil surface.
- Splitting P application with a smaller amount (~5kg/ha) with the seed at sowing can improve sowing efficiencies and multiple options are now emerging for application of the balance, including topdressing both pre and post sowing.

## Acknowledgements

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## Appendix

### Results

Table 5: Results - in crop and harvest observations

Rate (hg/ha)	Phosphorous Placement	Vegetation index			Yield		Oil				
		(38 DAS)	(69 DAS)	(111 DAS)	(t/ha)	(%)					
0	Nil	0.26	f	0.43	e	0.80	c	0.63	c	41.03	a
5	With	0.30	cde	0.64	bc	0.83	b	1.00	b	40.80	ab
15	With	0.29	de	0.67	bc	0.84	b	1.05	b	39.33	d
	IBS Split	0.30	cd	0.66	bc	0.85	ab	1.04	b	39.80	bc d
	0DAS TD- Split	0.31	bcd	0.70	ab	0.84	ab	1.01	b	39.45	cd
	38DAS TD- Split	0.33	ab	0.71	ab	0.84	ab	1.15	a b	39.72	cd
	69DAS TD- Split	0.30	bcd	0.62	c	0.85	ab	1.12	a b	40.37	ab c
	38DAS TD	0.25	f	0.54	d	0.85	ab	0.93	b	39.77	cd
	69DAS TD	0.25	f	0.45	e	0.84	b	0.99	b	39.75	cd
30	With	0.27	ef	0.62	cd	0.85	ab	1.15	a b	39.27	d
	IBS Split	0.35	a	0.72	ab	0.86	ab	1.15	a b	39.62	cd
	0DAS TD- Split	0.32	abc	0.77	a	0.87	a	1.14	a b	39.40	d
	38DAS TD- Split	0.30	bcd e	0.69	bc	0.86	ab	1.08	a b	39.27	d
	69DAS TD- Split	0.33	ab	0.66	bc	0.86	ab	1.30	a	39.56	cd
lsd	lsd	0.03		0.08		0.03		0.27		0.95	

Table 6: Results - plant establishment

Phosphorous Placement	Plant establishment (plants/m <sup>2</sup> )		Plant establishment (%)	
Nil	37.72	a	0.62	a
With5	37.68	a	0.62	a
With10	28.00	abc	0.46	abc
With30	17.33	c	0.29	c
With5 + IBS10	36.00	ab	0.59	ab
With5 + IBS25	40.00	a	0.66	a
With5 + TD10	37.67	ab	0.62	ab
With5 + TD25	25.72	bc	0.42	bc
lsd	11.89		0.20	