

Canola nutrition – Optimising canola phosphorus nutrition under high nitrogen strategies.

Trial code: GONU00720-2
Year: Autumn 2020
Location: Gollan, NSW
Collaborators: Nathan Simpson

Keywords

GONU007, canola nutrition, nitrogen, phosphorous, Gollan, soil test

Key findings

- Applying high rates of N fertiliser at sowing can reduce establishments even when broadcast ahead of sowing
- P nutrition is important to achieve good yield potentials with 20 kg P/ha more than doubled the yield even in a moderate P level soil (23 ppm Colwell P) compared to Nil P, without any added nitrogen (N).
- Increasing N rates had little impact unless P rates were increased beyond 20 kg/ha of P (90kg/ha of MAP)
 - Yields increased by ~990 kg/ha by increasing P rates from 20Kg/ha to 40 kg/ha and applying 200kg/ha of N
 - With a benefit net of additional fertiliser costs of \$160/ha
- To optimise yields growers should consider both P and N rates for the season and circumstance at hand
 - If growers plan on applying high rates of N fertiliser they may also want to consider increasing P rates beyond their traditional rates

Background

Canola areas planted in Central NSW has roughly doubled over the past 10 years¹, as its performance (attained yields) has steadily improved via several factors.

Previous work by GOA has shown canola to be highly responsive to applied N fertilisers with rates applied much greater than traditionally thought. In some cases increase of over 1t/ha have been achieved.

This may suggest a targeted yield for canola in the region should be reviewed upwards. However in many cases grower applied rates of P fertiliser has largely remained static and in many cases formulated based on the lower yield targets.

As supported by Leibigs Law which suggests yields will be limited by the most limiting input, it is postulated that for growers to capture the full value of higher N fertiliser applications, growers should also be increasing P fertiliser rates. To not do so will see very poor N fertiliser efficiencies and opportunity forgone.

Aim

- To demonstrate if increasing N rates in canola require corresponding P increases (or vice versa) to maximise yields.

Method

Four rates of N and P fertiliser rates where applied to canola to test for relative performance. The trial structure was a full factorial randomised and replicated design with 4 replicates.

Triphos was used as the P source for the Nil N treatments, MAP was used for all other treatments, urea was used as the N source.

1. Nitrogen at 4 rates (0, 50, 100, and 200 kg N/ha)
 - N applied through scatterbars on front of planter and incorporated by sowing (IBS)
 - Phosphorous at 4 rates (0, 10, 20, 40 kg P/ha)
 - For 0 N treatments: triphos was the P source
 - All other N treatments: MAP as P source (N balanced)

Results were analysed by ANOVA and results compared using an LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed statistically different unless otherwise stated.

Trial site details are outline in **Table 1** and the rainfall information is in Table 2 .

Table 1. Trial site details

Establishment date	Autumn 2020	Seeding rate	3.0 kg/ha
Crop and variety	Canola – V7503CL	Harvest date	6/11/2020
Sowing date	22/4/2020	Row spacing	27.5 cm
Sowing equipment	Knife point, press wheel	Soil type	Red brown fine sandy loam
Starting levels: N	0-10 cm: ~104 kg/ha 10-60 cm: ~102 kg/ha	Pre-sowing stubble management	Deep ripped and worked
Starting levels: Colwell P	0-10 cm: 23 ppm 10-30 cm: 7 ppm	Previous crop	Pasture

Table 2: Gollan rainfall for 2020 and the long-term average (LTA)

Mon	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
2020	40	123	128	117	27	31	116	43	47	88	17	160	937
LTA	71	58	57	41	44	46	45	46	45	55	58	56	622

Results

Plant establishment

- The average plant establishment was 23 plants/m², ranging from <9 to >30 plants/m².
- The addition of P, regardless of form, did not affect establishment.
- The addition of 100 kg/ha N or more (with no P fertiliser) reduced the plant establishment to less than 20 plants/m² (**Figure 1**).

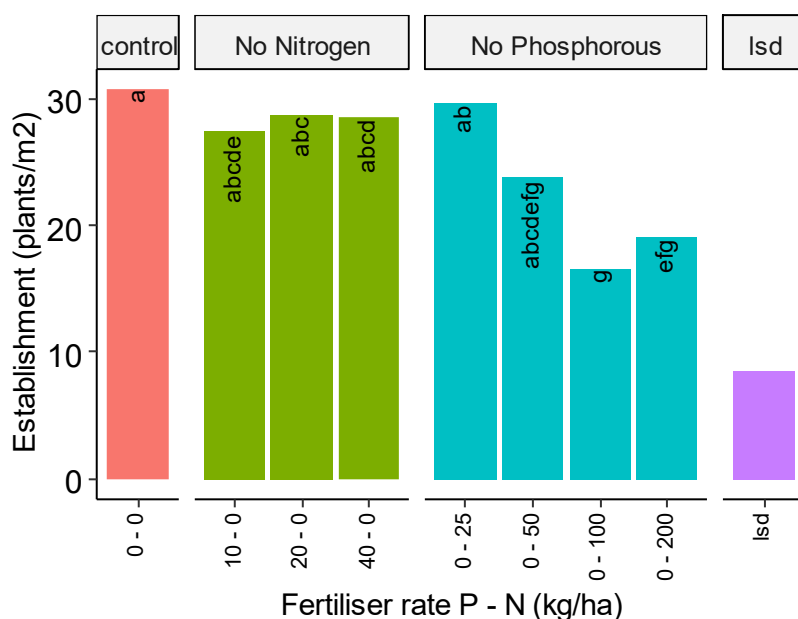


Figure 1. Plant establishment in response to increasing rates of N and P fertilisers. Treatments with the same letter are not significantly different.

Plant vigour

Plant vigour was assessed using a handheld ‘Green Seeker’ which determined an average vegetation index (VI) for each plot. Where no P was applied the average VI was 0.3, much lower than all other treatments which had a VI of greater than 0.5 (Figure 2).

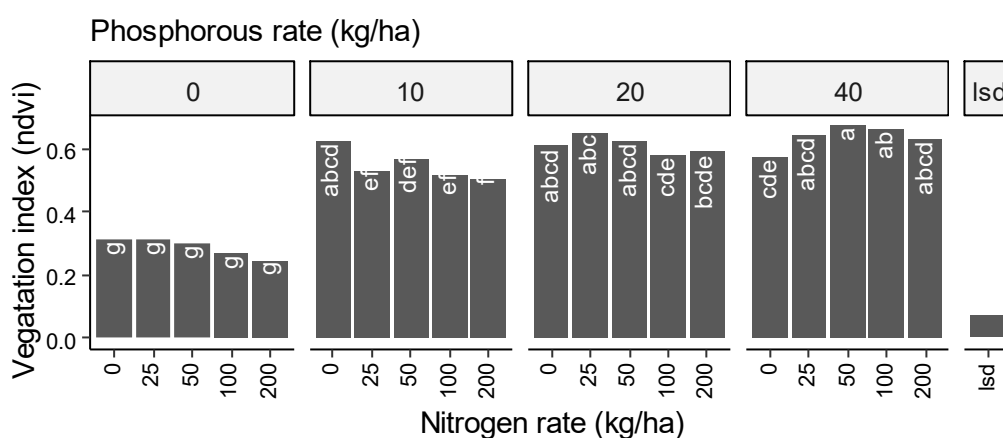


Figure 2. Vegetation Index 66 days after sowing in response to increasing rates of N and P fertilisers. Treatments with the same letter are not significantly different.

Yields

- Adding 20 kg P/ha more than doubled the yield (without added N).
- There was no yield response to N where 0, 10 and 20 kg P/ha were added.
- Where 40 kg P/ha was applied, yields and 0 N yields were close to 3 t/ha, almost double where 0 P was applied. Adding N up to 50 kg N/ha further increased yields to ~3.5 t/ha. (**Figure 3**).

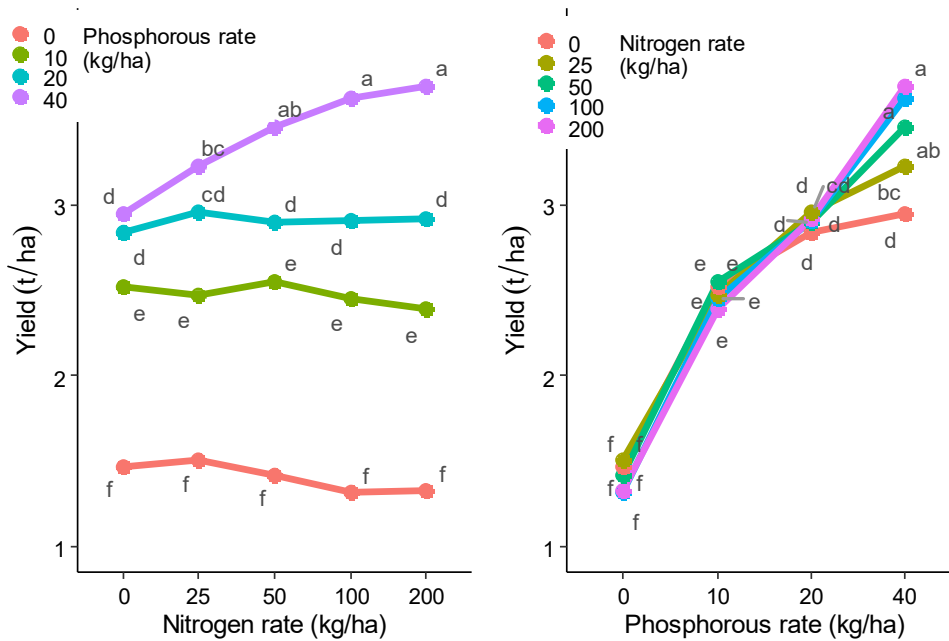


Figure 3. Canola yield responses to increasing rates of N and P fertilisers. Treatments with the same letter are not significantly different.

Oil and Protein

- Oil content decreased with increasing rates of N, while protein increased.

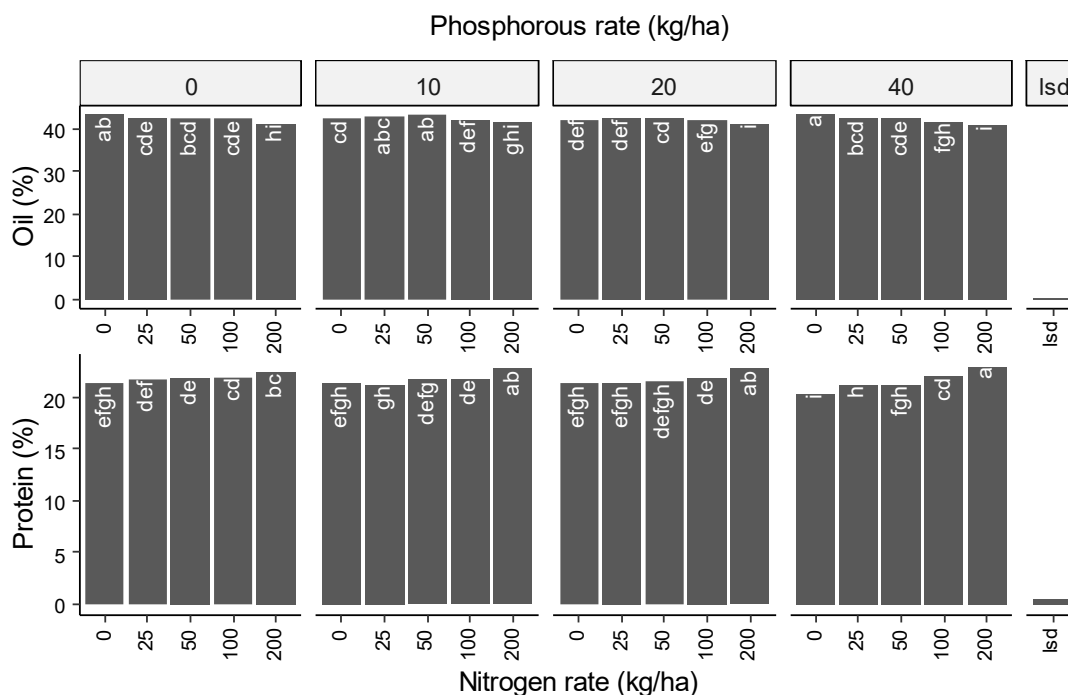


Figure 4. Canola oil and protein (%) response to increasing rates of N and P fertilisers. Treatments with the same letter in each variable are not significantly different.

Discussion

Phosphorus fertilizer is generally applied to canola at sowing which can affect establishment. Starter P fertilizer was placed below the seed in this trial to minimise this effect using a Deep Blade System. This strategy allowed for high P rates to be applied, with minimum establishment effect.

Nitrogen was applied at sowing using scatter plates in front of the seeder, and then incorporated by sowing. This would be considered a relatively 'safe' application method by most growers. However, in this trial, establishment was impacted with the higher N rates. The 3 lower rates (0, 25 and 50 kg N/ha) had >25% plants/m², which was more than the 2 higher rates (100 and 200 kg N/ha). Caution should be used when applying N (as urea) at canola sowing, even as a topdressing.

At 66 days after sowing the growth of the crop (NDVI) indicated that differences in establishment were becoming less obvious, and this may be partially due to the highly compensatory nature of canola growth and that even the treatments with the poorest establishment the populations were commercially acceptable.

This trial was in a paddock that had previously been pasture and was selected because it was likely to be low in both N and P. Soil testing confirmed moderate levels of P (23 ppm) and moderate to high levels of N (~200 kg/ha). The site was highly responsive to P, as the soil tests indicated, with yields more than doubling with the addition of 20 kg P/ha. Going from 20 – 40 kg P/ha saw a small, but not significant, increase in yield (0.1 t/ha) where no N was applied.

The high levels of N detected with soil testing was unexpected given the degraded pasture history. The yield from the treatment of 0 N and the highest P rate was 2.8t/ha, suggesting that there was some N in the profile. A canola crop at this yield would require approximately 110 kg/ha N.

This trial clearly showed that increasing N without sufficiently addressing P did not result in any benefit. However, once the threshold of the limiting nutrient, in this case P, was reached, there was considerable benefit from addition of N. Interestingly the highest 'change in net income' was where 40 kg P was applied with 100 kg N, an increase of \$300/ha over where 20 kg P was applied with the same N rate.

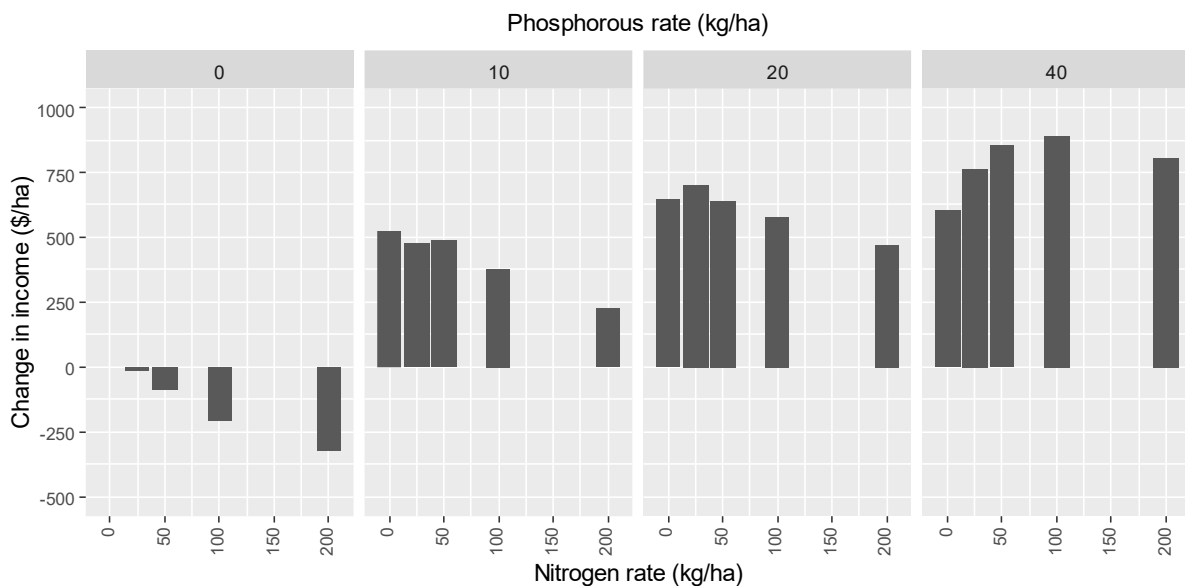


Figure 5. Change in income (compared to when 0 fertiliser was applied). Determined by calculating gross income and subtracting fertiliser costs¹. Income as a response to increasing rates of N and P fertilisers. Treatments with the same letter in each variable are not significantly different.

Conclusions

- Canola is responsive to P fertilizers in soils with low starting P levels.
- P deficiency can severely limit canola yields and is possibly more limiting than N.
- Deficiencies of the most limiting nutrient may have to be addressed before responses in other nutrients will be observed.
- In high yielding seasons/environments high fertiliser of both N and P rates may be required to optimise returns.
- Soil testing is a useful tool to determine which nutrients are limiting, such as N and P.
- If growers wish to target high rates of N fertiliser applications, they should ensure that adequate P fertiliser is applied, with the same said of applying high P rates they may need to target higher N rates to capture the full benefit of the investment.

¹ Assumptions: Canola \$

Acknowledgements

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Appendix

Table 3. Results.

Phosphorous	Nitrogen	Plant establishment (plants/m ²)	NDVI		Yield (t/ha)	Oil	Protein (%)	screenings	Test weight (kg/hl)	Moisture %
			Mid (Vegetative index)	Early						
0	0	30.8a	0.31g	0.20h	1.5f	43.2ab	21.5efgh	1.0a	64.8cd	6.7cde
	25	29.7ab	0.31g	0.20h	1.5f	42.5cde	21.8def	0.8abc	64.8cd	7.0bcde
	50	23.8abcdefg	0.30g	0.20h	1.4f	42.7bcd	21.9de	0.8abc	64.8cd	6.5de
	100	16.5g	0.27g	0.19h	1.3f	42.5cde	22.0cd	0.8ab	64.8cd	6.6de
	200	19.0efg	0.25g	0.20h	1.3f	41.3hi	22.5bc	0.7bcde	64.6d	7.5abcd
10	0	27.4abcde	0.62abcd	0.28ab	2.5e	42.6cd	21.4efgh	0.6cdef	65.5ab	7.5abcd
	25	23.3abcdefg	0.53ef	0.24efg	2.5e	43.0abc	21.3gh	0.4ef	65.5ab	6.8cde
	50	21.3bcdefg	0.57def	0.25defg	2.5e	43.2ab	21.8defg	0.7bcd	65.5ab	6.3e
	100	21.7bcdefg	0.52ef	0.23g	2.4e	42.2def	21.9de	0.8abc	65.3ab	7.0bcde
	200	17.4g	0.50f	0.24efg	2.4e	41.5ghi	22.8ab	0.6bcdef	65.5ab	7.7abc
20	0	28.8abc	0.61abcd	0.30a	2.8d	42.3def	21.4efgh	0.6bcdef	65.2abc	7.4abcd
	25	24.7abcdefg	0.65abc	0.28abc	3.0cd	42.3def	21.5efgh	0.6bcde	65.3ab	7.5abcd
	50	26.7abcdef	0.63abcd	0.26bcdef	2.9d	42.6cd	21.6defgh	0.5def	65.7a	7.1bcde
	100	19.0efg	0.58cde	0.25defg	2.9d	42.0efg	21.9de	0.6bcde	65.4ab	7.3abcd
	200	18.3fg	0.59bcde	0.24fg	2.9d	41.1i	22.8ab	0.6bcde	65.6ab	7.9ab
40	0	28.5abcd	0.58cde	0.25defg	3.0d	43.4a	20.4i	0.6bcdef	65.1bcd	7.7abc
	25	23.8abcdefg	0.64abcd	0.27bcd	3.2bc	42.7bcd	21.2h	0.6bcdef	65.3abc	8.0ab
	50	27.9abcd	0.67a	0.28ab	3.4ab	42.5cde	21.3fgh	0.7bcde	65.4ab	7.9ab
	100	20.6cdefg	0.66ab	0.27abcde	3.6a	41.9fgh	22.1cd	0.4f	65.6ab	8.0ab
	200	20.1defg	0.63abcd	0.25cdefg	3.7a	41.0i	23.1a	0.8abc	65.3ab	8.4a
lsd	lsd	8.5	0.07	0.03	0.3	0.6	0.5	0.2	0.5	1.0