GOA Trial Site Report

Canola nutrition – pushing nitrogen and phosphorous limits

Trial Code: GONU00716-2

Season/Year: Autumn 2016

Location: 'Glenbrook', Alectown

Collaborators: Alan Westcott and Peter Yelland

Keywords

GONU00716, Canola nutrition, nitrogen, phosphorous,

Editor's Note

Soil testing revealed a severe 'acid throttle', at this site, which limited yield potential. The research team note the importance of taking this into account when assessing the significance of the data (see Box 1).

Take home messages

Yield response is possibly higher for the nutrient with lower availability in the profile. At this site both N and P were very low, and showed a similar yield response at each step increase in both nutrients.

Soil testing is useful for assessing limiting nutrients.

Soil constraints (such as an acid throttle) can complicate nutrient management.

Background

Average farm area planted to canola in Central NSW has roughly doubled over the past 10 years[1], as its profitability has improved (improved prices, bonuses for specific varieties) and because of its good fit as a cereal break crop. Because there is a move toward continuous cropping systems, reliance on inherent soil fertility to drive yields is becoming more limiting. Trails assessing phosphorous (P) response in canola have been variable. For example, canola VSAP trails in Nyngan 2014 showed a response to added P, while no response at Trangie[2] in the same year. GOA (and other) research has shown canola is highly responsive to added nitrogen (N).

It has therefore been hypothesised that increasing productivity of canola through addition of one likely deficient nutrient, would also increase the demand for other likely deficient nutrients. This trial seeks to determine if there is such a relationship between nitrogen and phosphorous and the implications for canola management.

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[1] AGSURF Data (apps.daff.gov.au/AGSURF/agsurf.asp

[2] grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2014/02/canola-agronomy-research-in-central-west-nsw

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Aim

- To determine if increasing Nitrogen rates on canola require corresponding increases in phosphorous rates.

Methods

To investigate the influence of phosphorous and nitrogen rates on canola yields a matrix of 4 rates for each nutrient was devised and paired with each other.

1. Nitrogen at four rates (0, 50, 100, and 200 kg N/ha) as urea
2. Phosphorous at four rates (0, 15, 30, 45 kg P/ha) as triphos

A randomised complete block design with 3 replications across 6 ranges was used. Results were analysed by ANOVA and results compared by using LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed statistically different unless otherwise stated.

Table 1. Trial site details

Trial Establishment Date	Autumn 2016	**Seeding rate**	2.5 kg/ha
Crop and Variety	Canola – 44Y89	**Harvest Date**	22/11/2016
Sowing date	04/05/2016	**Row Spacing**	27.5 cm
Sowing equipment	Double Boot Tyne	**Soil type**	Sandy Clay Loam
Site nutrition: Nitrogen	0-10 cm: ~22 kg/ha 10-60 cm: ~ 112 kg/ha	**Pre-sowing stubble Management**	Standing stubble
Colwell P	0-10 cm: 10 ppm	**Previous Crop**	Wheat

Results

Plant count

Plant establishment was assessed by plant counts. Addition of P fertiliser had no impact on plant population, however, addition of N reduced population at the highest rate by about 20% (**Figure 1**). There was no significant impact on plant population by interaction between N and P.

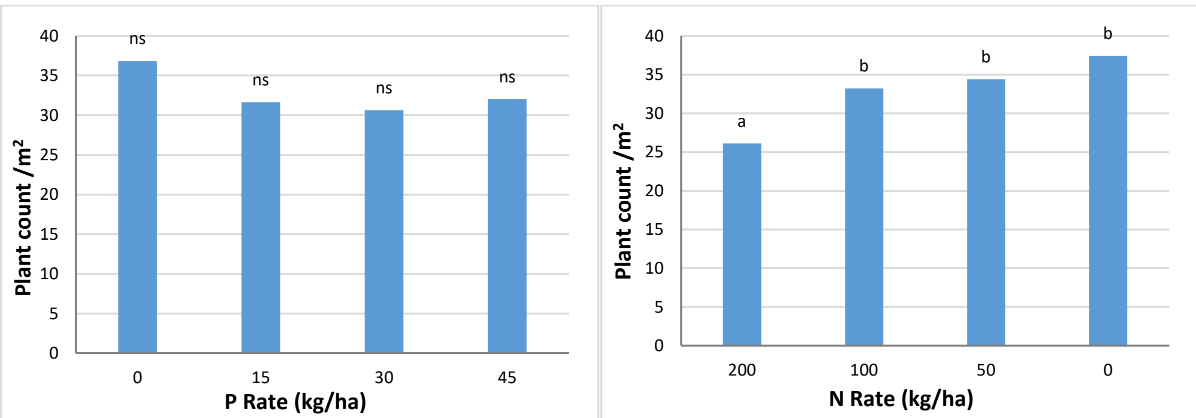

Figure 1. Canola plant populations (plant count/m^2) response to increasing rates of nitrogen and phosphorous fertilisers.

Yields

Yields increased with both increasing N and P rates (regardless of the rate of the other nutrient), as illustrated in **Figure 2**. Responses were recorded up to the highest rates of both nutrients. Yield difference between no P and highest P rate was close to 0.5 t/ha while response to N was almost the same margin.

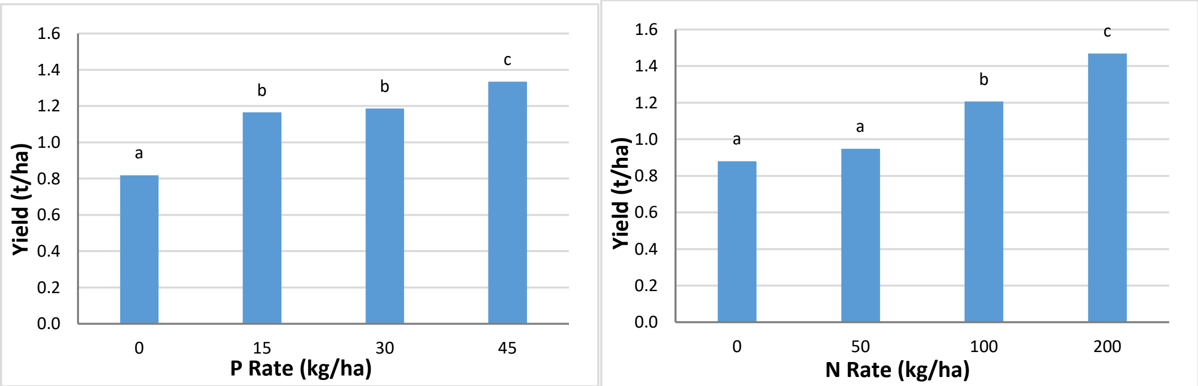

Figure 2. Canola yield (t/ha) response to increasing rates of nitrogen and phosphorous fertilisers.

There was a significant interaction between N and P rates on yields. Yields increased in response to the addition of both nutrients. P appeared to be more limiting than N. For example in **Figure 3** (below) where the lowest rate of P (15 kg/ha) with no nitrogen yield response was around 400 kg/ha. In contrast where the lowest rate of N was applied (50 kg/ha) and no P, yield response was 200 kg/ha.

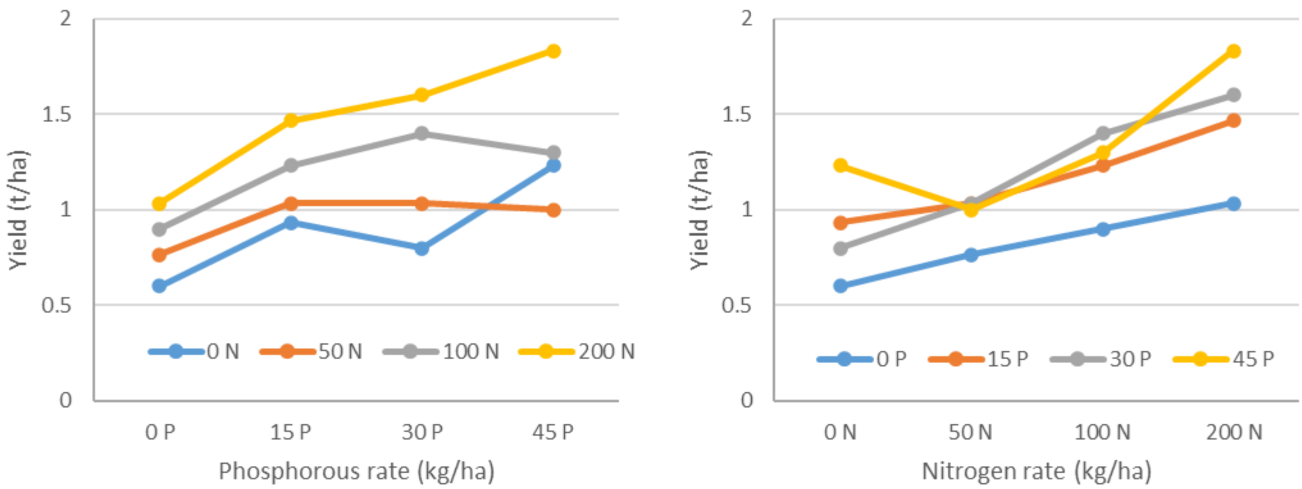

Figure 3. Canola yield (t/ha) response interaction to increasing rates of nitrogen and phosphorous fertilisers (lsd = 0.15).

Discussion

This site was confounded by an acidity despite having lime applied in 2014. Soil testing at and after planting revealed pH_{Ca} of 4.9 and 4.2 at 5 and 15 cm depths respectively. Corresponding aluminium saturation was 4.8% and 38.0% respectively. Current canola recommendations[3] suggest that canola should not be grown in soils with pH_{Ca} less than 5.2, and aluminium concentration above 5%. This site

[3] Canola Growth and Development, PROCROP, NSW DPI, 2011

is borderline at 5 cm depth and much worse at 15 cm. In paddocks where lime has been applied with little or no incorporation, soil testing to ensure adequate remediation of soil acidity is highly recommended. If acid throttles are detected tolerant crops should be considered and/or investing in liming and its thorough incorporation (see Box 1).

Plant Counts: N (as urea) was predrilled prior to planting (on the same day) to depth 4-6 cm. P was applied in the sowing pass through a DBS approximately 4 cm below seed placement. Other research assessing P placement suggests that this degree of separation would not result in any harm to germinating canola plants, as was observed in this trial. That the highest rate of N depressed plant establishment indicating that by pre-drilling and sowing directly over the same drill line is not a safe practice. Yield results from these same treatments suggest that the resulting plant stand more than compensated for lower establishment. However the question remains “could yield have been better if this limitation was not in place”.

Yields: there was a 200% increase in yields from no fertiliser to the top rates of both N and P . The near linear yield increase to increasing rates of fertiliser (yield increase by incremental rate steps, **Figure 4**) gives confidence that increasing rate of one nutrient requires an increase in rate of the other.

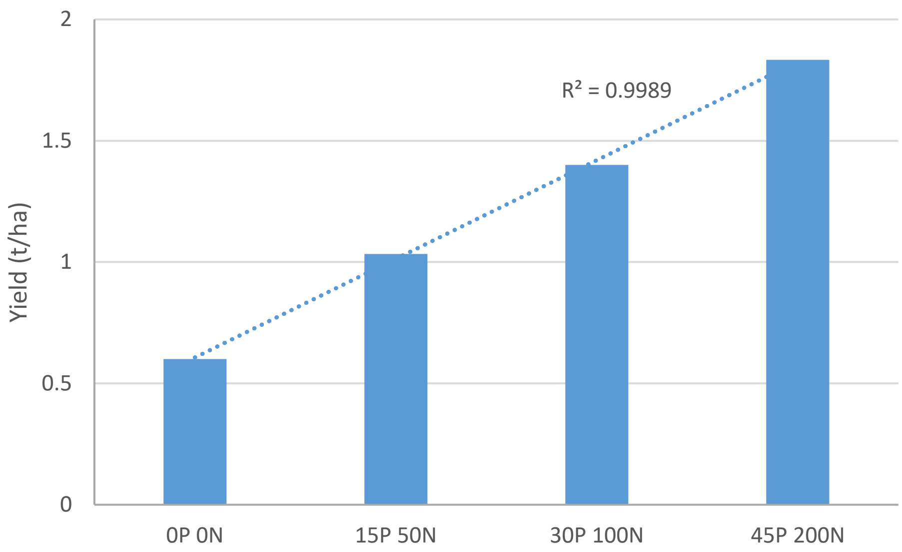

Figure 4. Canola yield (t/ha) response interaction to increasing paired rate increments of nitrogen and phosphorous fertilisers.

Soil testing at revealed very low soil P (10 ppm) while N levels were moderate. This may explain why P appeared to be more limiting at this site. The ‘acid throttle’ may have also limited canola’s ability to extract N from deeper in the profile, and therefore making applied N more accessible in the very wet season.

Box 1. CASE STUDY: Soil testing and ‘acid bands’.

At this site, soil samples were collected manually (with a hand auger). The sampler tested pH using a field test kit and detected a possible acid band. Subsequently samples were sent for analysis from the ‘bulked’ 0-10 cm and 10-60 cm soil depths. The results did not reflect the ‘acid throttle’ detected with the field test kit (see the Table below).

As the season progressed (2016 was a very wet winter with very favourable growth conditions for canola), it became obvious that the crop was not performing to expectations. It was decided to retest the site to see if the acid throttle may have been the cause. Targeted testing confirmed the field test and indicated that the site had the potential to severely restrict growth and subsequent yield of canola.

<table>
<tr><th rowspan="2">Depth
(cm from surface)</th><th colspan="2">General soil testing</th><th colspan="2">Targeted testing</th></tr>
<tr><th>pH_{Ca}</th><th>Aluminium saturation %</th><th>pH_{Ca}</th><th>Aluminium saturation %</th></tr>
<tr><td>0</td><td rowspan="3">5.6</td><td rowspan="3"><1</td><td></td><td></td></tr>
<tr><td>5</td><td>4.9</td><td>4.8</td></tr>
<tr><td>10</td><td></td><td></td></tr>
<tr><td>15</td><td rowspan="6"></td><td rowspan="6">Tested only for nitrates and sulfur</td><td>4.2</td><td>38</td></tr>
<tr><td>25</td><td>4.7</td><td><1</td></tr>
<tr><td>35</td><td>5.6</td><td><1</td></tr>
<tr><td>50</td><td>6.2</td><td><1</td></tr>
<tr><td>60</td><td></td><td></td></tr>
</table>

Conclusion

If one nutrient is limiting it is likely that it will potentially limit the yield response to the other likely deficient nutrient.

Soil testing is a useful tool to test for limiting nutrients.

Soil constraints (such as an acid throttle) can complicate nutrient management.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of GRDC. The authors would like to thank them for their continued support. Special thanks to the Westcott family at Alectown who hosted this trial.

DISCLAIMER — TECHNICAL

This report has been prepared in good faith on the basis of information available at the date of publication without any independent verification. The Grains Research and Development Corporation,

Appendix

Table 2. Impact of plant populations, P rates and P placement on yield and % oil of canola. Results followed by the same letter are not significantly different.

P-rate (kg/ha)	N rate	Yield (t/ha)		Plant Establishment Count (plants/m^2)	
0	0	0.58	a	21.90	ns
0	50	0.77	ab	26.76	ns
0	100	0.89	bc	29.81	ns
0	200	1.03	cde	33.05	ns
15	0	0.95	bc	31.02	ns
15	50	1.03	cde	33.45	ns
15	100	1.24	ef	36.09	ns
15	200	1.44	fg	37.10	ns
30	0	0.77	ab	23.93	ns
30	50	1.00	bcd	31.83	ns
30	100	1.40	fg	37.10	ns
30	200	1.57	g	39.33	ns
45	0	1.21	def	33.45	ns
45	50	0.99	bcd	31.22	ns
45	100	1.30	f	36.50	ns
45	200	1.84	h	41.97	ns
	lsd	0.29			

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David Harbison

2470 Mitchell Highway

Molong
NSW 2866

Report Print Date: 26/05/2016
Agent/Dealer:
Advisor/Contact: David Harbison
Phone: 02 6367 7213
Purchase Order No: CK292588

Grower Name : David Harbison
Sample No: 021774787
Paddock Name: GOA Canola
Sample Name: Canola 0-10 cm
Sample Depth (cm): 0 To 10

Nearest Town: MOLONG
Test Code: 2002-139
Sample Type: Soil
Sampling Date: 4/05/2016

Analyte / Assay	Units	Value
pH (1:5 Water)		6.3
pH (1:5 CaCl2)		5.6
Electrical Conductivity (1:5 Water)	dS/m	0.06
Chloride	mg/kg	<10
Organic Carbon (OC)	%	0.7
Nitrate Nitrogen (NO3)	mg/kg	16
Phosphorus (Colwell)	mg/kg	10
Phosphorus Buffer Index (PBI-Col)		11
Sulphate Sulphur (KCl40)	mg/kg	4
Cation Exchange Capacity	cmol(+)/kg	3.7
Calcium (Amm-acet.)	cmol(+)/kg	2.9
Magnesium (Amm-acet.)	cmol(+)/kg	0.4
Sodium (Amm-acet.)	cmol(+)/kg	<0.02
Potassium (Amm-acet.)	cmol(+)/kg	0.43
Available Potassium	mg/kg	170
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium (KCl)	mg/kg	<9.0
Aluminium Saturation	%	<1.0
Calcium % of cations	%	79.0
Magnesium % of cations	%	9.6
Sodium % of cations	%	<1.00
Potassium % of cations	%	12.00

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8 South Road, Werribee VIC 3030

NATA Accreditation No: 11958 Tel: 1800 803 453

Certificate of Analysis is available upon request. Email: lab.feedback@incitecpivot.com.au

Sample No: 021774787 Version: 1 Page 1 of 2

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Molong
NSW 2866

Report Print Date: 26/05/2016
Agent/Dealer:
Advisor/Contact: David Harbison
Phone: 02 6367 7213
Purchase Order No: CK292588

Grower Name :	David Harbison	**Nearest Town:**	MOLONG
Sample No:	021774786	**Test Code:**	2002-093B
Paddock Name:	GOA Canola	**Sample Type:**	Soil
Sample Name:	Canola 10-60 cm	**Sampling Date:**	4/05/2016
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Chloride	mg/kg	<10
Nitrate Nitrogen (NO3)	mg/kg	16
Ammonium Nitrogen	mg/kg	1
Sulphate Sulphur (KCl40)	mg/kg	4

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
* One or more components of this test are below their detection limit. The value used is indicative only.

Analyses conducted by Nutrient Advantage Laboratory Services
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