Coolah Trial Site Report

Assessing the impact of residual nitrogen following a canola crop on the subsequent wheat crop

Trial Code:	GONU01016-2
Year:	Canola 2015 followed by wheat 2016
Location:	'Kurrajong Park', Coolah
Collaborators:	Paspaley Farms (Andrew McFadyen)

Keywords

GONU010, Canola nutrition, residual nitrogen, wheat following canola, nitrogen management, rotations

Take home message

Unused nitrogen (N) fertiliser applied to canola crop can carry through the fallow for use by the subsequent crop.

Net profit over a two-year period from N rates used in the initial canola crop increased with increasing rates of applied N.

Background

Research undertaken by GOA has regularly shown that increasing N fertiliser rates on canola can optimise yields and profitability. This research also showed there was a minimal risk of 'haying' canola crops off by over applying N. These points alone raise the potential benefits of substantially lifting N application rates in canola. However, a number of farmers have questioned "what happens to any excess nitrogen in the event of a crop failure, say due to frost or disease"?

There is a risk that in some years yield improvements through higher rates of applied N may not be realised because of poor seasonal conditions such as low spring rainfall. However, if growers could have confidence that unused N could be carried through for use by following crops, the application of high N rates may not be seen as risky.

GOA established five trials in 2015 investigating canola nitrogen responses with rates up to 200 kg N/ha. Following these trials there was an opportunity to plant the same trial site to wheat, which could then be assessed for yield and quality performance in relation to the 2014 N fertilisation strategy.

This document is supplementary to the trial protocol for Canola Nitrogen (GONU00115-2).

This trial aims to test whether application of various N rates applied to 2015 canola has any impact on residual soil nitrogen levels (post crop) and what influences these may have on the subsequent wheat yield.

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Aim

- Assess residual N levels available for the subsequent crop.
- Determine the impact on yields of subsequent rotation crop (wheat) of any residual N.

Methods

The trial directly overlayed the previous year's canola trial, which investigated yield response to varied rates of applied N. The 2015 canola trial and subsequent 2016 wheat trial used a randomised complete block design with three replicates. Small plots of approximately 2 by 10 meters were sown with a plot seeder. Yields were assessed with a plot harvester. Trial details are outlined in **Table** 1 below.

Table 1. Trial site details

Trial Establishment Date	Autumn, 2015 (Canola), Autumn 2016 (Wheat)		
Crop and Variety	Wheat – EGA Gregory	Seeding rate	55 kg/ha
Sowing date	30/5/2016	Harvest Date	6/12/2016
Seedling equipment	Double Boot Tyne	Row Spacing	27.5 cm
Crop Nutrition (kg/ha)	100 Triphos	Soil type	Clay Loam
Previous Crop (and yield)	Canola (trial)	Pre-sowing stubble management	Direct Drilled
Soil nutrient status	Colwell P: 35 ppm	Nitrogen -	See section below

2015 Canola trial consisted of the following treatments-

- Two canola varieties- a high and low biomass line (444Y84 and 43C80)
- Five N rates (0, 50, 100, 150 and 200 kg N/ha)
- Three application timings, sowing, budding and a split timing (50:50- sowing & budding)
- With and without sulphur (20 kg/ha)

One variety of wheat (EGA Gregory) was sown in 2016 with a starter rate of phosphorus applied as Trifos. Results presented below are where no further additions of N fertiliser were applied in 2016.

Results

Soil nitrogen was assessed prior to sowing canola in April 2015 (site characterisation) and prior to sowing wheat in April 2016 in the 0, 100 and 200 kg N/ha treatments. In 2015 starting soil N levels were calculated to be 30 kg N/ha. In 2016 soil N levels were higher where 200 kg/ha of N was applied in 2015. It was calculated at 66 and 114 kg N/ha respectively for 0 and 200 kg N/ha treatments. While most of the additional N was in the top 30 cm, the amount at each depth sampling in the 200 kg/ha treatment was roughly double the amount found in the 0 N treatment, indicating some movement of nitrates though the soil profile in the preceding 12 months (Figure 1).

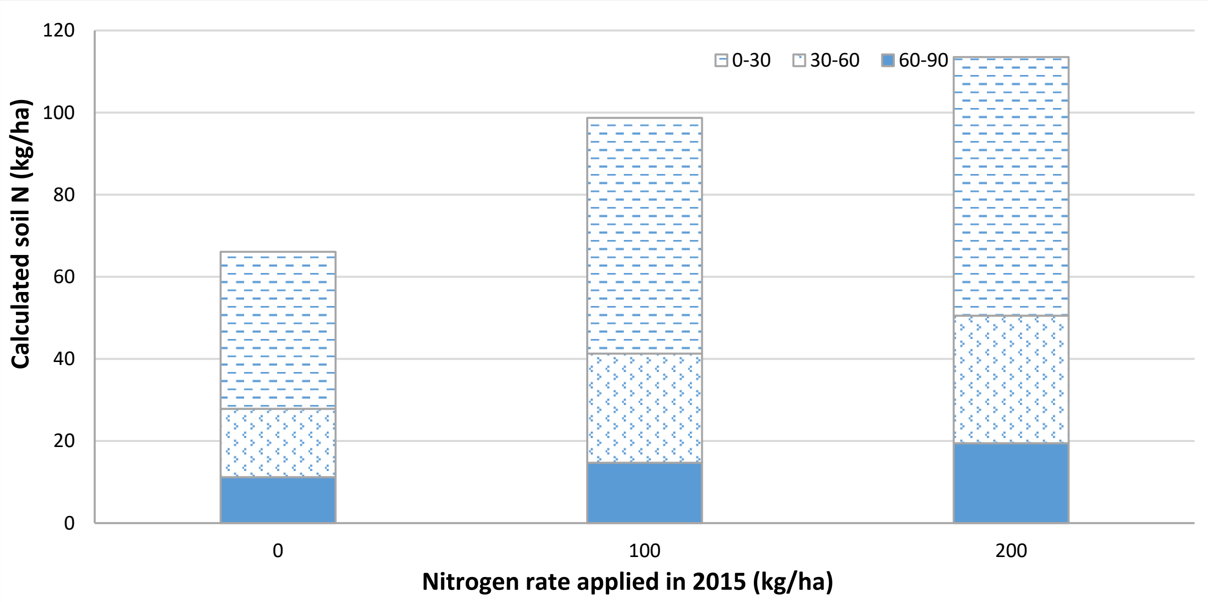

Figure 1. Calculated soil nitrogen levels (kg/ha) measured in April 2016, at three soil depths, in response to three rates of applied N as urea in 2015.

Yields: Applying 200 kg N/ha to the 2015 canola crop resulted in an additional 0.9 t/ha yield compared to nil N treatment. Wheat yields in 2016 also increased following the 2015 application of 200 kg/ha of N, increasing by 0.8 t/ha compared to nil N as illustrated in **Error! Reference source not found.** below and detailed in Table 2.

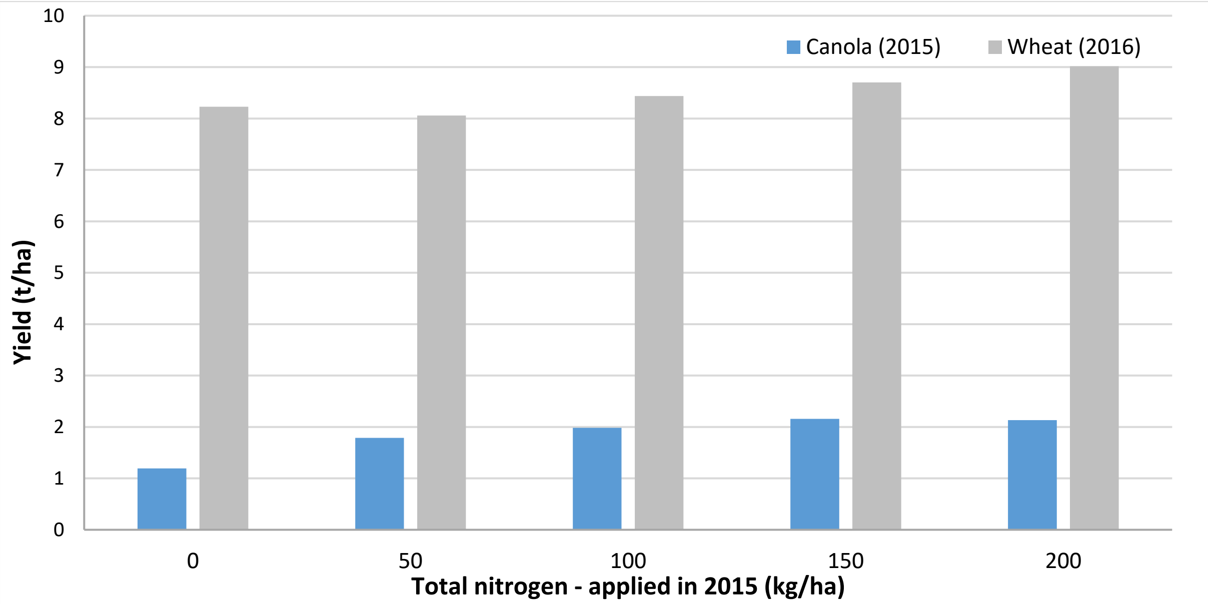

Figure 2. Wheat (2016) and canola (2015) yields at various levels of N applied in 2015.

Grain quality: Canola Oil % (2015) decreased by 6 % as N rate increased from nil to 200 kg/ha (**Figure 3**). Inversely protein increased by 2% in wheat where N increased from nil to 200 kg/ha. Screenings were very low and did not show much response to N.

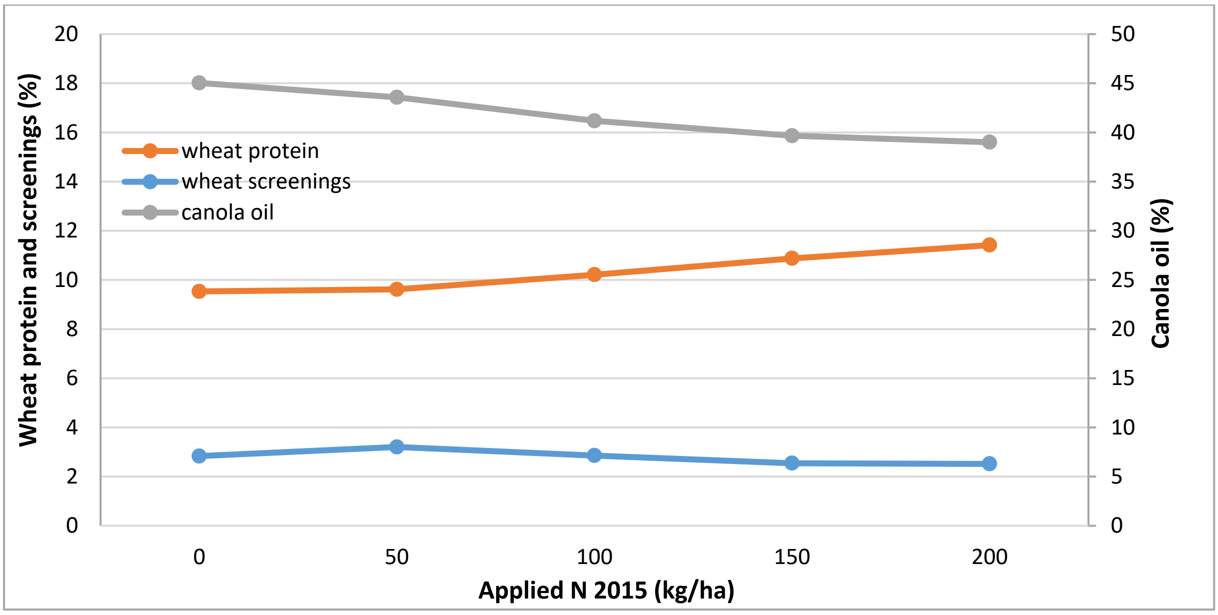

Figure 3. Grain quality results from the canola (2015) and wheat (2016) crops.

Discussion

Soil testing in 2016 indicated that there was ~50kg/ha more soil N (as nitrate N), where the highest rate of N (200 kg/ha) was applied in 2015. Nitrogen extraction (wheat yield x protein x 0.16) of approximately 120 kg/ha on the no N treatments was almost double the nitrate level measured in the soil prior to planting. Possible reasons may be that N was available in other parts of the soil profile not tested (i.e. below 90 cm) and/or was tied up in organic forms. However, soil testing did pick up differences between treatments that reflected wheat performance. These results tend to indicate that soil nitrate tests may not give a good indication of absolute soil N availability. However they do give a good indication of relative fertility between fertiliser treatments.

N rates applied in 2015 did have a positive impact on yields of 2015 and 2016 crops as shown in **Error! Reference source not found.**, although canola yield tended to plateau for N rates of 100 kg/ha and above.

Profitability: Net profit level in canola declines at N rates above 150 kg/ha (**Figure 4**). However, wheat yields and protein in 2016 increased as 2015 N rate increased, resulting in net profit in the 2nd year continuing to increase up to the maximum rate of N, 200 kg/ha. Applying 200 kg/ha N in 2015 resulted in a combined increased net profit over the two years of $675 more than applying no N.

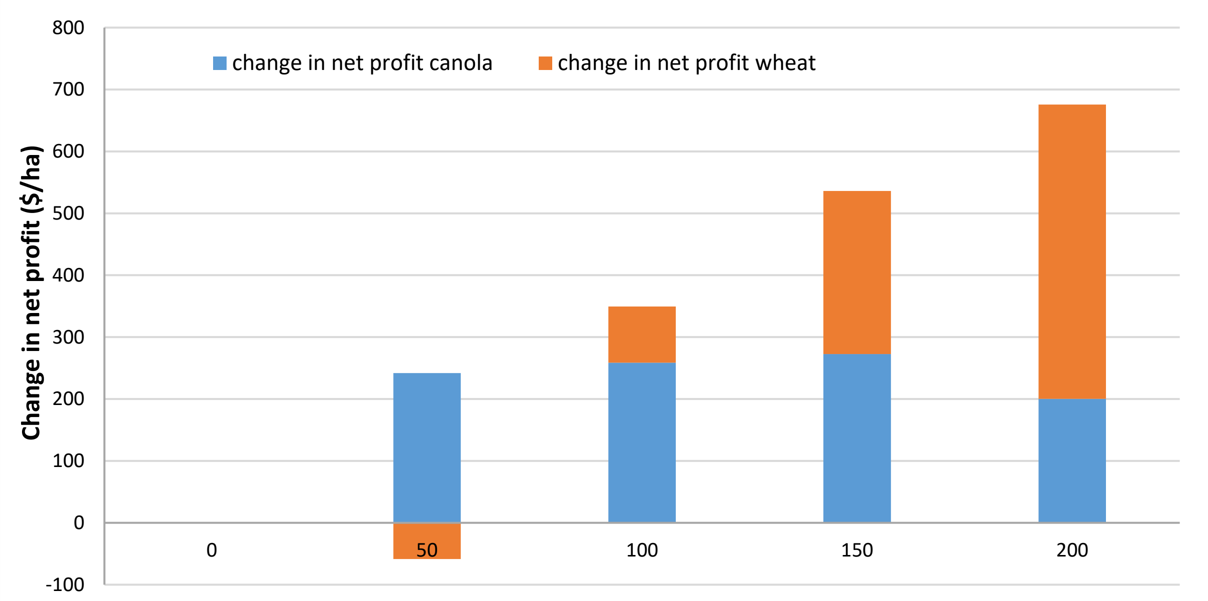

Figure 4. Change in net profit in 2015 and 2016 crop in response to various N applied in 2015 compared to nil applied N

Canola oil % declined significantly as N rate increased (6%), which reduced the price obtained per ton of canola grain and subsequent net profit. However, decline in net profit was also driven by increasing fertiliser costs from increasing N rates.

Wheat protein levels also increased as N rate increased and at the highest rates was close to 11.5%, which would bring grain into a higher quality grade (and price) than the no N treatments. Improvement in grain quality had a greater influence on change in net profit than increase in yield for the highest N rate.

Conclusion

This trial clearly demonstrated that nitrogen not utilised on one crop can remain in the soil and be available for the subsequent crop. Soil testing showed that some of this nitrogen will also move deeper into the profile, albeit slowly. It also highlighted some limitations of soil nitrate testing to estimate available N (and hence make N fertiliser rate decisions).

2015 yields were optimised from where 100 - 150 kg/ha of nitrogen was applied. However, the 2016 results show that the highest N rate, 200 kg/ha, applied in 2015, resulted in the best carry through to the following wheat crop, which showed strong positive yield responses. Economically net profit over two years was greatest at the highest N application rate applied in 2015.

What was not addressed by this trial is whether N use efficiency could be higher if only the "optimal rate" of N in 2015 was applied (i.e. 150 kg/ha) and the remaining portion of N (50 kg/ha) was applied in to wheat in 2016. This may deserve further investigations.

In the context of the original aim of the trial, growers can have increased confidence to applying N fertiliser at rates towards the upper end of canola yield potential. In the case that canola yield is not optimized the subsequent crop is able to take advantage of any residual N.

Acknowledgements

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Appendix

Table 2- Yield and grain quality in canola (2015) and wheat (2016) in response to various N rates applied in 2014

Canola Treatments 2015			Wheat yield and quality 2016					
N Rate	N timing	Variety	Yield (t/ha)		Protein (%)		Screenings (%)	
0	NA	**Y84**	7.8	I	9.0	O	3.1	BCD
0	NA	**C80**	8.5	BCDEFGHI	10.0	HIJKLM	2.6	BCD
50	Bud	**Y84**	7.9	FGHI	9.7	KLMN	3.4	ABC
50	Bud	**C80**	8.6	BCDEFG	10.3	GHIJK	2.5	BCD
50	Sow	**Y84**	8.1	DEFGHI	9.6	LMNO	3.4	ABC
50	Sow	**C80**	7.9	HI	9.6	LMNO	4.2	A
50	Split	**Y84**	8.0	EFGHI	9.4	MNO	2.9	BCD
50	Split	**C80**	7.8	I	9.1	NO	2.8	BCD
100	Bud	**Y84**	8.6	BCDEFG	10.6	EFGH	3.1	BCD
100	Bud	**C80**	9.1	AB	10.9	CDEFG	3.1	ABCD
100	Sow	**Y84**	8.3	CDEFGHI	9.8	JKLM	2.6	BCD
100	Sow	**C80**	8.2	CDEFGHI	9.9	IJKLM	2.6	BCD
100	Split	**Y84**	7.9	GHI	9.9	IJKLM	2.7	BCD
100	Split	**C80**	8.6	BCDEFGH	10.1	HIJKL	3.1	ABCD
150	Bud	**Y84**	8.8	ABC	11.0	CDEF	2.9	BCD
150	Bud	**C80**	9.2	AB	11.4	BCD	2.2	D
150	Sow	**Y84**	8.6	BCDEFGH	10.4	FGHIJ	2.4	CD
150	Sow	**C80**	8.3	CDEFGHI	10.7	EFGH	3.5	AB
150	Split	**Y84**	8.7	ABCD	10.8	DEFG	2.1	D
150	Split	**C80**	8.6	BCDEF	11.0	CDEF	2.2	D
200	Bud	**Y84**	9.3	A	12.2	A	2.1	D
200	Bud	**C80**	9.1	AB	11.8	AB	2.6	BCD
200	Sow	**Y84**	8.7	ABCDE	11.0	CDE	2.8	BCD
200	Sow	**C80**	8.8	ABCD	10.5	EFGHI	2.7	BCD
200	Split	**Y84**	9.1	AB	11.5	BC	2.6	BCD
200	Split	**C80**	9.1	AB	11.4	BCD	2.3	D

Values followed by letter in the same letter in adjacent columns indicate that there is no significant difference between the values.