Geurie Trial Site Report

Wheat performance following aggressive high nitrogen strategies in canola crops

Trial Code: GONU01015-3

Season/year: Autumn 2014

Location: 'Larry's Plains', Geurie NSW

Collaborators: Gary Evans

Keywords

GONU01015-3, Canola nutrition, residual nitrogen, wheat following canola, nitrogen management, rotations, Geurie

Take home message

Unused nitrogen (N) fertiliser applied to canola crops can often carry through for use by subsequent wheat crops

Increasing N rates in canola not only resulted in higher canola yields but also the subsequent wheat crops.

Net profit over a two-year period from increasing N rates was maximised at the highest rate of 200 kg/ha of N applied in 2014. This brought an additional $546/ha profit after additional fertiliser costs.

This could give farmers some confidence to apply higher rate of N fertiliser to canola given that the following wheat crop may also benefit from the higher rates of N applied.

It is unlikely though that N use efficiencies would be maximised in this case. Unrequired N may be more efficient if deferred until the subsequent crop to avoid potential losses from the system.

Background

Trial work undertaken by GOA has often supported increasing N fertiliser rates on canola to optimise potential yields and profitability. In a number of GOA trials the rates of N required to optimise yield was often far in excess of what would be considered typical canola fertiliser practice. These trials also showed that there was a very minimal risk of 'haying' canola crops off by over applying N. These two points raise the potential benefits of substantially lifting N application rates in canola.

However, there is a risk that in some years' yield improvements through higher rates of applied N may not be realised due to poor seasonal conditions such as low spring rainfall. Although, if growers could have confidence that the unused N could be carried through for use by the following seasons crop the application of such high rates may not be perceived as so risky.

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

This document is supplementary to the trial protocol for Canola Nitrogen (GONU00214-5).

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This trial will test whether application of various rates of nitrogen in the 2014, in the Tullamore canola nutrition trial has any impact on residual soil nitrogen levels (post crop) and what influences these may have on the subsequent crop yield.

Aim

- Assess the residual N levels ahead of sowing 2015 in relation to rates of applied fertiliser N applied at sowing in 2014.
- Determine the impact on yields of subsequent rotation crop (wheat) of any residual N.

Methods

This trial directly overlayed the previous year's canola trial, which investigated the yield response to varied rates of applied N. The 2014 trial and subsequent 2015 trial used a randomised complete block design with three replicates. Small plots of approximately 2 x 10 meters were sown with a research plot seeder and yields were assessed with a plot harvester. Trial details are outlined in Error! Not a valid bookmark self-reference. below.

Table 1. Trial site details

Trial Establishment Date	Autumn, 2015		
Crop and Variety	Wheat - Gregory	**Seeding rate**	45 kg/ha
Sowing date	7/5/2015	**Harvest Date**	23/11/2015
Seedling equipment	Double Boot Tyne	**Row Spacing**	27.5 cm
Crop Nutrition (kg/ha)	100 Triphos	**Soil type**	Clay
Previous Crop	Canola (trial)	**Pre Sowing Stubble Management**	Direct Drilled
Soil nutrient status	Colwell P: 66 ppm		

The 2014 trial consisted of the following treatments-

- Two canola varieties - a high (44Y84) and low (43C80) biomass line
- 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)

In 2015, one single variety of wheat (EGA Gregory) was sown with only a starter rate of phosphorus applied as Trifos. The results presented below are where no further additions of N fertiliser were applied in 2015

Results

Residual Nitrogen was tested prior to sowing in April 2014 and again in April 2015 but only in the 0N and 200 kg N/ha sowing treatments). In 2014 the starting soil N levels were in the order of 95 kg N/ha. In 2015 the soil N level where in the order of 54 and 118 kg N/ha where 0 and 200 kg N/ha were applied respectively in the previous canola crop as illustrated in Figure 1 below.

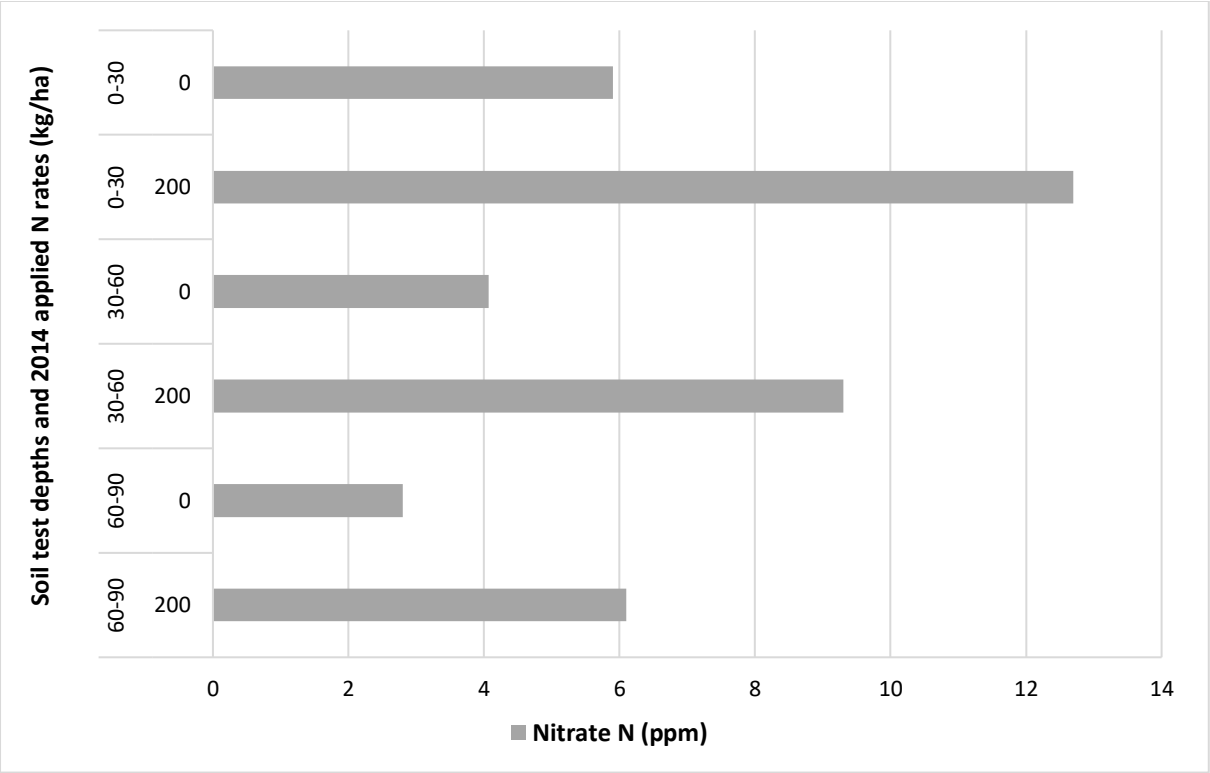

Figure 1. Soil nitrate levels (ppm) measured in April 2015, at three soil depths, in response to two rates of applied N as urea in 2014.

Yields: Wheat and canola yields increased as the amount of nitrogen applied in 2014 increased as illustrated in Figure 2 and detailed in Table 2. Applying 200 kg N/ha on the canola crop of 2014 resulted in an additional 0.88 t/ha wheat in 2015 and an additional 1.34 t/ha of canola in 2014 compared to the 0 N treatment.

Canola oil and wheat protein: canola oil percentage (%) decreased as N rates increased, the highest rate of applied N reduced oil content by 3.8%. Wheat protein increased as N rates increased with the highest rate of N resulting in 1.2% higher protein than the 0 treatment. The N rate applied in 2014 had no impact on screening % in the wheat. These results are detailed in Table 2.

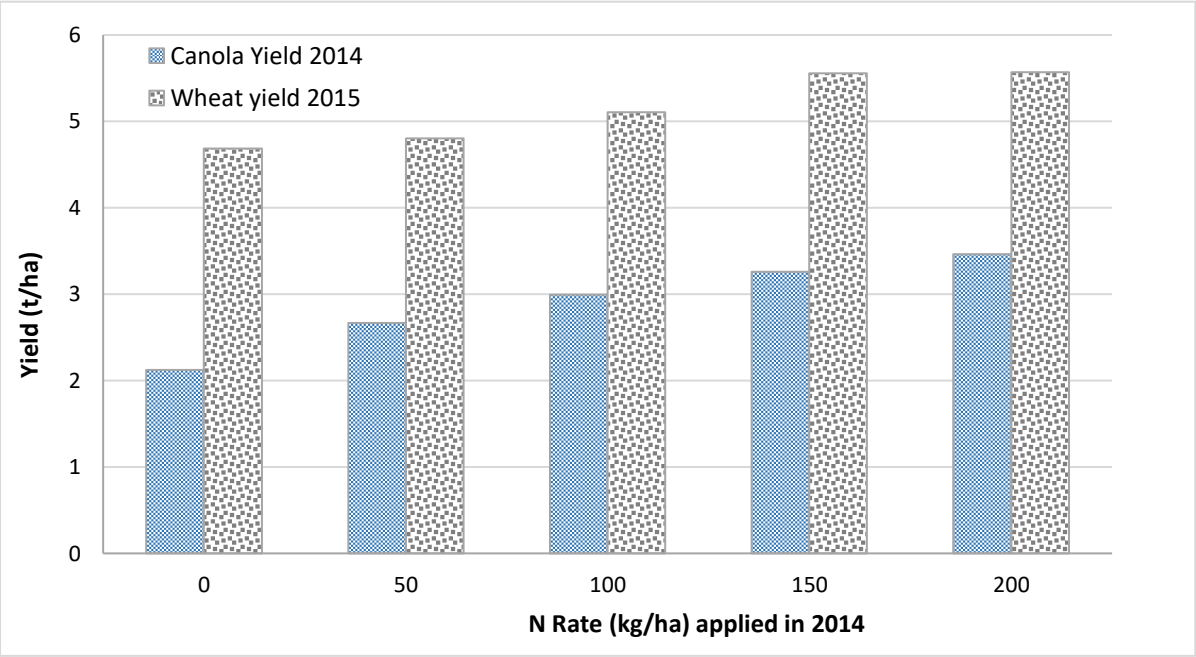

Figure 2. Wheat (2015) and canola (2014) yields at various levels of N applied in 2014[1]

Discussion

Soil testing at this trial site in 2015 indicated that there was ~64 kg/ha more soil N as nitrate N, where higher rates of N fertilisers where applied in 2014. However, the relative increase in available soil nitrate N falls far short of what would be expected of the rates of N (200 kg/ha) applied even when considering significant levels of crop removal in 2014 of around 140 kg/ha. It is assumed that the balance of the residual N may not have not been lost from the system but most likely present in some other form of N not assessed by the soil test used. Suffice to say that the soil tests have indicated that some of the unused N of 2014 has carried through in the form of nitrate N.

The N rates applied in 2014 and resulting higher residual N levels did have a positive impact on the yield of both the 2014 and 2015 crop as discussed above. Figure 3 details the change in net profit (increase in gross income less additional fertiliser costs) in both the 2014 and 2015 crops when compared with the 0N application of N in 2014. As seen, net profit in the 2014 canola crop continues to increase with increasing N rates up to 200 kg/ha. Additionally, net profit in the wheat of 2015 also continues to increase with the increasing N rate in 2014 up to the highest N rate. As a result, the highest cumulative net profit from the single addition of N in 2014 by the two crops is achieved by the highest N rate of 200 kg/ha of N and results in an increase in net profit of $546/ha.

[1] Results based on only plots from 2014 that received all N applied at seeding only

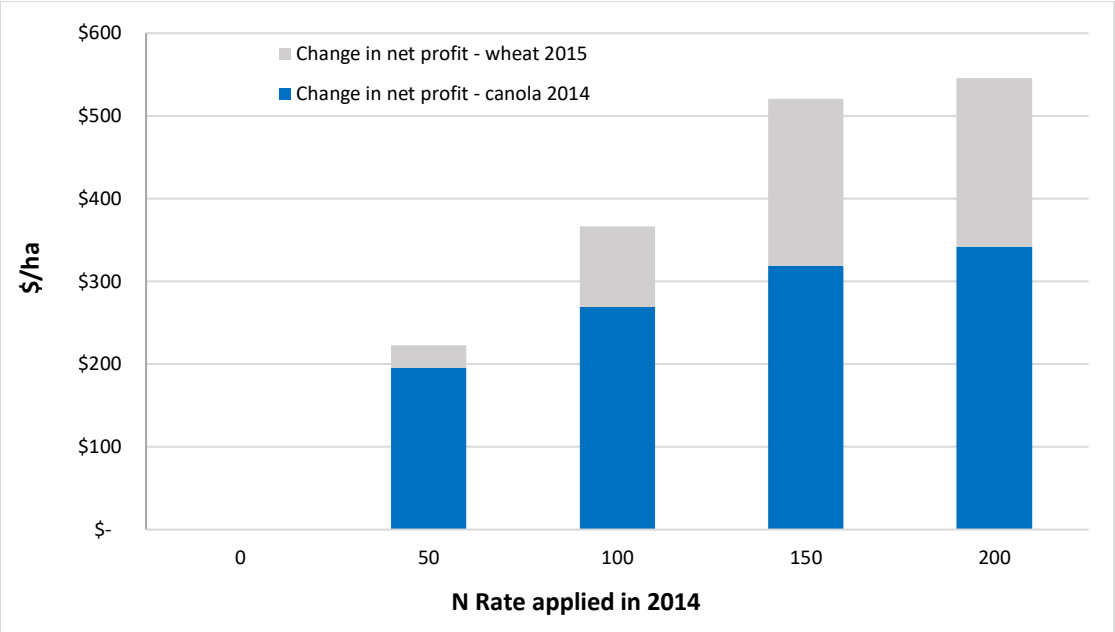

Figure 3. Increase in net profit in 2014 and 2015 in response to various N rates applied in 2014 compared to 0 applied N

High rates of applied N had a surprisingly small effect on grain protein in the 2015 wheat. Application of 200 kg/ha of N in 2014 only resulted in grain protein lifting from 6.7 to 8.4%. This increase would not have improved the receival grade for the wheat. The higher N rates had a much more notable effect on the oil % in the 2014 canola crop reducing it by ~3.8% following the 200 kg/ha of N. However, it should be noted that even such a reduction in oil % was more than compensated by yield increases as shown in Figure 3 which takes into account oil bonification in its' calculations.

Conclusion

This trial has confirmed that canola is highly responsive to applied N, in this trial increasing canola yields by 1.3 t/ha. Net profit continued to increase right up to what would be considered an extremely high rate of applied N at 200 kg/ha, equivalent to ~430 kg/ha of urea. However, wheat planted in the second year showed a similar trend of increasing yields and net profit with the highest net profit for the two-year rotation resulting from the highest N rate.

Unfortunately, the trial did not meet the original aims of this work where some N was unjustified in the canola crop, allowing investigation of the impact of carryover N into the following wheat crop. But it did strongly support a very aggressive approach to N rates in a two-year canola > wheat rotation with the highest N rate resulting in an increase in net profit of $546/ha.

However, wheat yields did appear to plateau from 150 kg/ha to 200 kg/ha of N but wheat protein was extremely low, indicating that wheat yield may in fact been still N limited. Which also raises the question of the relative efficiencies of applied N in the context of the year of application which deserves further investigations

Acknowledgements

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Appendix

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

N rate applied 2014	2014				2015					
	Canola yield		Oil%		Wheat yield		Protein %		Screenings %	
0	2.12	D	45.4	A	4.688	B	6.9	B	1.945	A
50	2.66	C	44.5	A	4.803	B	6.65	B	1.648	A
100	2.99	BC	43.4	B	5.108	AB	6.85	B	1.763	A
150	3.26	AB	42.1	C	5.558	A	8.05	A	1.875	A
200	3.46	A	41.6	C	5.567	A	8.1	A	2.215	A
L.S.D	0.43		1.0		0.5		0.56		0.62	

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