Tullamore Trial Site Report

Wheat performance following aggressive high nitrogen strategies in canola crops

Trial Code: GONU01015-1

Season/Year: Autumn 2015

Location: 'Allawah', Tullamore, NSW

Collaborators: Neville Jones

Keywords

GONU01015-1, Canola nutrition, residual nitrogen, wheat following canola, nitrogen management, rotations, Tullamore

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. This brought an additional $280/ha profit after additional fertiliser costs.

This could give farmers some confidence to apply higher rate of N fertiliser to canola given unused N may be utilised by the following wheat crops.

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. But 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 sites

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 Nutrition trials (GONU00214-5).

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 Table 1 below.

Table 1. Trial site details

Trial Date	Autumn, 2015		
Crop and Variety	Wheat - Gregory	**Seeding rate**	45 kg/ha
Sowing date	5/5/2015	**Harvest Date**	19/11/2015
Seedling equipment	Double Boot Tyne	**Row Spacing**	27.5 cm
Crop Nutrition (kg/ha)	Triphos @ 100	**Soil type**	Clay Loam
Previous crop	Canola (trial)	**Pre-Sowing Stubble Management**	Direct Drilled
Soil nutrient status	Colwell P:15 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 Soil Nitrogen was tested prior to sowing in April 2014 and again in April 2015 but only in the 0 and 200 kg N/ha treatments. In 2014 the starting soil N levels were calculated to be in the order of 100 kg N/ha. In 2015 the soil N levels were higher where the 200 kg/ha of N was applied compared to the 0 N. It was calculated that 57 and 82 kg N/ha was present where 0 and 200 kg N/ha was applied respectively. **Figure 1** details the soil test results from April 2015.

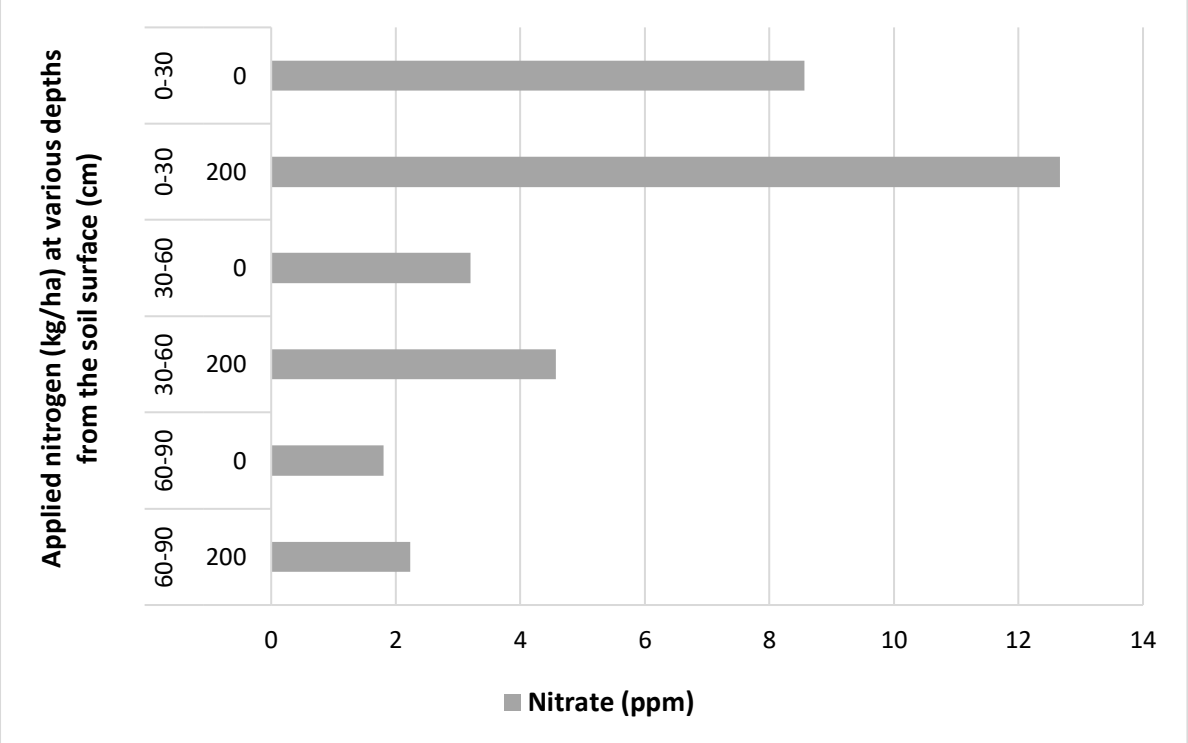

Figure 1. Soil nitrate levels (ppm) measured in April 2015, at three soil depths, in response to two rates of applied N as urea in 2014.

Yields: Applying 200 kg N/ha on the canola crop of 2014 resulted in an additional 0.84 t/ha canola yield compared to the 0 N treatment. Wheat yields in 2015 also increased following the 2014 application of 200 kg/ha of N, increasing by 0.75 t/ha compared to the 0 N as illustrated in **Figure 2** below and detailed in **Table 2**.

Oil, Protein and screening: Oil % decreased by 3.93% as the N rate was increased from 0 to 200 kg/ha. Inversely protein increased in the wheat by 2.5% as the N increased from 0 to 200 kg/ha. Screenings in the wheat also increased as the N rate increased over the same range by 1.6%.

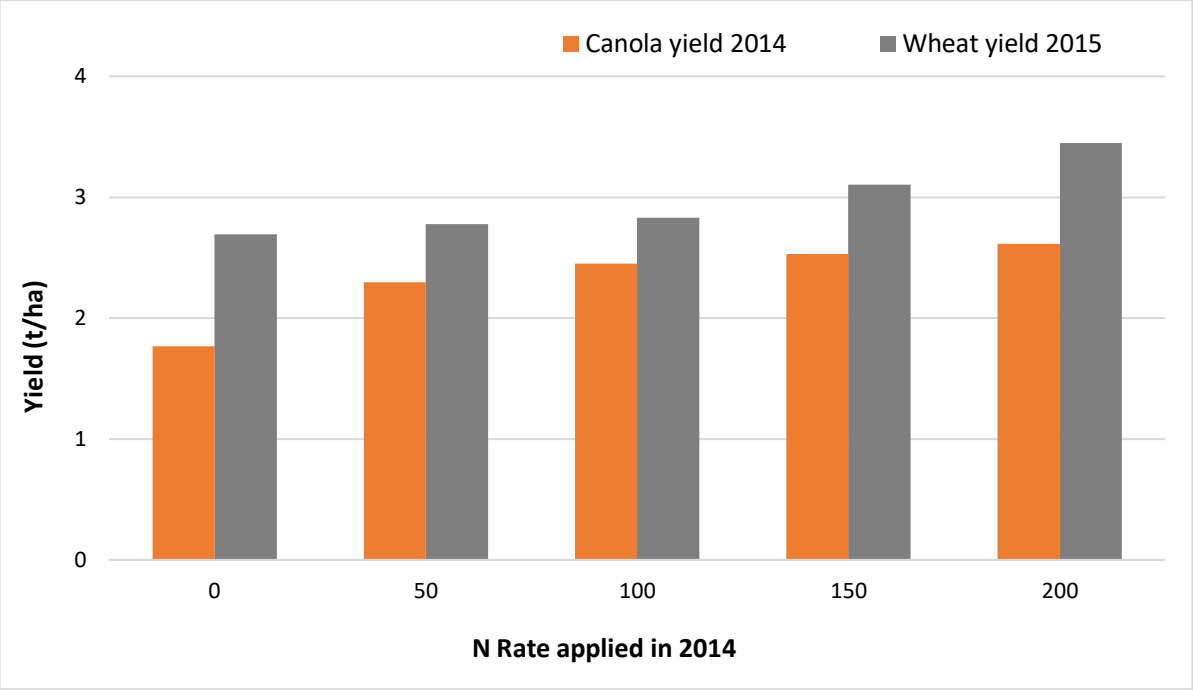

Figure 2. Wheat (2015) and canola (2014) yields at various levels of N applied in 2014[1].

Discussion

Soil testing at this trial site in 2015 indicated that there was ~25kg/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 applied even when considering crop removal in 2014. 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 the higher residual N levels did have a positive impact on the yields of the 2014 and 2015 crops as shown in **Figure 2**. However, as can be seen canola yield gains from successive increases in N applied tended to decrease once rates moved above 50 kg/ha of N. Once the costs of additional fertiliser is deducted, the net profit level in 2014 declines from 50 kg/ha of N applied as shown in **Figure 3** below.

However, wheat yields in 2015 increased as the 2014 N rate increased resulting in the 2015 net profit continuing to increase up to the maximum rate of 200 kg/ha. Applying 200 kg/ha of N in 2014 resulted in a combined increased net profit over the two years of $282 more than applying 0 N illustrated in **Figure 3**.

[1] Results based on only 44Y84 plots of 2014 which received all N applied at seeding

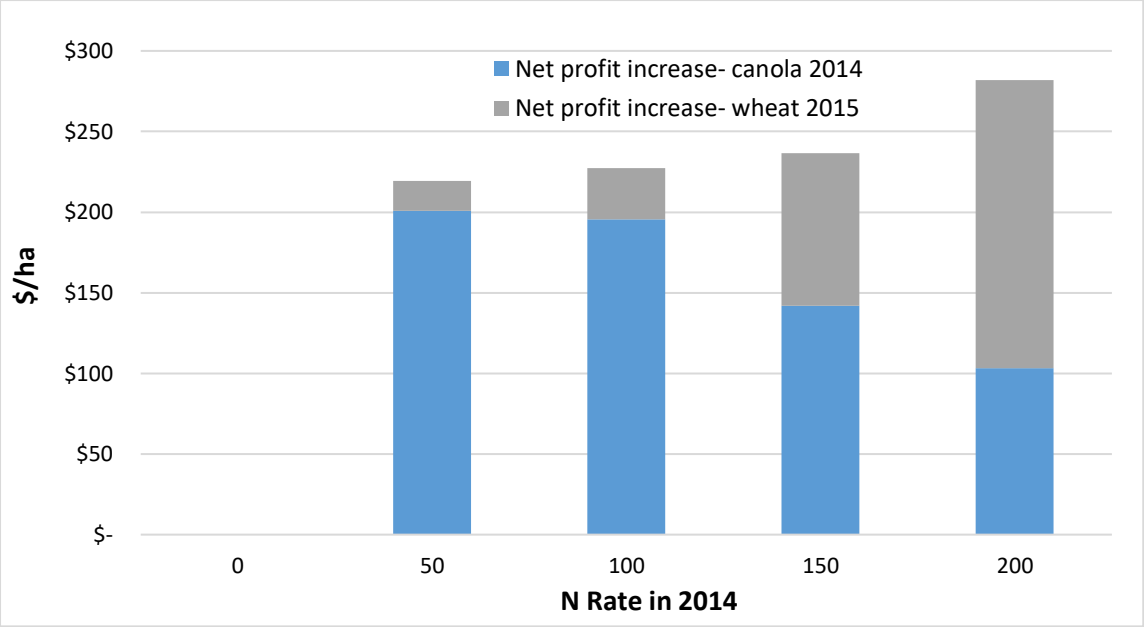

Figure 3. Increase in net profit in 2014 and 2015 crop in response to various N applied in 2014 compared to nil applied N

Canola oil % declined quite significantly as the N rate increased (3.93%), which would have reduced the price per ton of canola grain. However, the decline in net profit was largely driven by the increasing fertiliser costs from increasing N rates with insufficient yield increases compensate.

The wheat protein levels also increased as N rate increased but in none of these cases did the protein exceed 10.5%, the level which is required to lift the wheat into a higher grade and price/ton.

Screenings increased as N rates increased but not above the 5% threshold over which could have resulted in down grading of the wheat into lower priced grades.

Conclusion

Recent research has confirmed that canola is highly responsive to applied N, however, application of higher rates can be perceived to be risky as some N may be unutilised in the event of a drier season and possibly lost to the system.

This trial has demonstrated such a scenario where only 50 kg/ha has seen net profit optimised in a canola phase. However, the trial has shown that where rates of N were applied in excess of this rate, the unused N was carried through to the following wheat crop, which showed strong positive yield responses.

Economically, the net profit over two years was greatest at the highest N application in 2014.

What cannot be addressed by this trial is whether N use efficiency could be higher if only the optimal rate of N in 2014 was applied and the unwarranted portion of N was applied in the second year. It would be expected this would be the case with less chances for losses through leaching, denitrification or robbed by weed growth etc. This may deserve further investigations.

However, in the context of the original aim of the trial growers can be confident that when applying more liberal rates of N fertiliser on canola crops, if some potential of increasing N rates is unrealised that the subsequent crop is able to take advantage of any residual N.

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 the GRDC, the authors would like to thank them for their continued support. Special thanks goes out to Neville Jones who hosted this trial.

Appendix

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

N Rate 2014	2014				2015					
	Canola Yield		Oil %		Wheat yield		Protein %		Screenings %	
0	1.77	B	48.10	A	2.70	B	7.07	C	2.51	B
50	2.30	A	47.13	AB	2.78	AB	7.40	C	2.69	B
100	2.45	A	46.13	BC	2.83	AB	8.23	B	3.38	AB
150	2.53	A	44.70	CD	3.10	AB	8.23	B	2.21	B
200	2.61	A	44.17	D	3.45	A	9.57	A	4.07	A
L.S.D	0.43		1.66		0.7		0.76		1.2	

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