GOA Trial Site Report

Wheat – comparison of fallow nitrogen application methods

Trial Code: GONU011163

Year: Winter 2016

Location: Collie, NSW

Trial Partners: Andrew Freeth

Keywords

GONU011, wheat nutrition, nitrogen placement, banding, broadcast, fallow nitrogen

Take home messages

Banding high rates of nitrogen at sowing is not recommended.

Broadcasting urea either just before (IBS) or just after sowing can be more profitable when compared to drilling under the seed.

Application of large rates of nitrogen can provide high levels of return on investment in favourable seasons.

Background

Changes in the regions farming systems is seeing increasing need to apply higher rates of nitrogen (N) to optimise crop performance. Finding opportunities to apply this additional N can be challenging, the traditional method of pre-drilling nitrogen is time consuming, and the windows for topdressing with incorporating rainfall within 2-3 days (and of sufficient amount) can be limiting.

GOA has been undertaking research to understand whether fallow application of nitrogen (N) fertiliser can improve wheat yields and grain quality by using fallow rainfall and time to move nitrogen deeper into the profile. This is partially driven by anecdotal evidence that topdressing N may be less available to crops in a dry finish, sometimes resulting in high screenings and lower than expected protein and yields.

In some of the fallow applied N trials conducted in 2015 on wheat, pre-drilling high N rates in the fallow could not be accounted for in soil testing nor in subsequent yields[1]. The most plausible reason is that some N was lost to denitrification, where very high N rates concentrated in a band were exposed to ideal conditions for denitrification, i.e. hot and wet conditions, that occurred after summer storms.

In addition, in dry seasons some nutrients may become stratified, research in Queensland has shown significant benefit from deep application of phosphorus (a much less mobile nutrient) as it can become unavailable in dry conditions. It is plausible that nitrogen might also be prone to the same limitations,

[1] Soil testing 108 days after application could only account for 27% of the applied N where 200 kg/ha applied in the fallow. http://grainorana.com.au/documents?download=100

where its horizontal availability may be limited when banded, and/or its vertical availability may be limited where it is surface applied.

Recent research by NSW DPI has shown that volatilisation losses from urea applied to the soil surface following broadcast application is much lower than previously thought, however questions remain over whether it is not more efficient and safer to incorporate or bury applied urea to minimise volatilisation losses.

This led to the question as to whether alternative application methods that reduce concentration of nitrogen could also increase nitrogen usage efficiency. This research may also provide growers with confidence in a range of application options.

This research evaluates the potential impact on N efficiency of alternate methods of urea application on subsequent wheat yields.

DISCLAIMER

Following is a report on a scientific experiment. It may contain some treatments that are not applicable for the situation, manner or rate at which they are used in this trial. This document or anything else resulting from, construed or taken from this or by GOA or its representatives should not be taken as a suggestion, recommendation or endorsement.

Aim

- Compare yield and grain quality response to different N application placements in fallow
- Compare wheat yield and grain quality response to applied nitrogen

Methods

A small plot trial was established in the summer fallow and included treatments with the following N application timings.

- Broadcast and incorporated
- Drilled
- Broadcast

For the 'broadcast and incorporated' treatments fertiliser was spread by hand on the plots and incorporated using a plot seeder fitted with Horward Bagshaw PSS tyne openers set at 27.5 cm spacings. 'Drilled' banded fertiliser was placed approximately 6-8 cm deep resulting in 3-4 cm of soil cover over the fertiliser band. Broadcast treatments were spread by hand. To ensure that all plots had the same 'tillage' effect, the tyne seeder also passed through the broadcast treatments prior to application. Nitrogen was applied as urea at 4 rates supplying 0, 50, 100, and 200 kg N/ha.

Table 1. Trial site details

Trial Establishment Date	Summer 2016		
Crop and Variety	Wheat -Gregory	Seeding rate	50 kg/ha
Sowing date	19/5/2016	Harvest date	30/11/2015
Seedling equipment	Double Boot Tyne	Row spacing	27.5 cm
Crop Nutrition (kg/ha)	100 triphos	Soil type	Clay Loam
Previous Crop	Canola	Pre-sowing stubble management	Standing stubble
Soil residual nutrition (at sowing)	Colwell P ~ 25 ppm, Sulphur ~ 8 ppm	Nitrogen	0-90cm ~ 32 kg/ha

For the purpose of analysis and discussion unless otherwise stated, treatments and their effects are compared to UTC. Outcomes are statistically analysed by ANOVA at a 95% confidence interval with means compared by the LSD method. Any references to differences between treatments should be assumed to be statistically different unless otherwise stated.

Results

Vegetation index was assessed 91 days after sowing (DAS). In all treatments where nitrogen was applied, broadcast treatment had a significantly higher vegetation index than the drilled treatment. At the higher N rates (100 and 200 kg N/ha) broadcast and incorporated treatment also had a higher vegetation index than the drilled treatment.

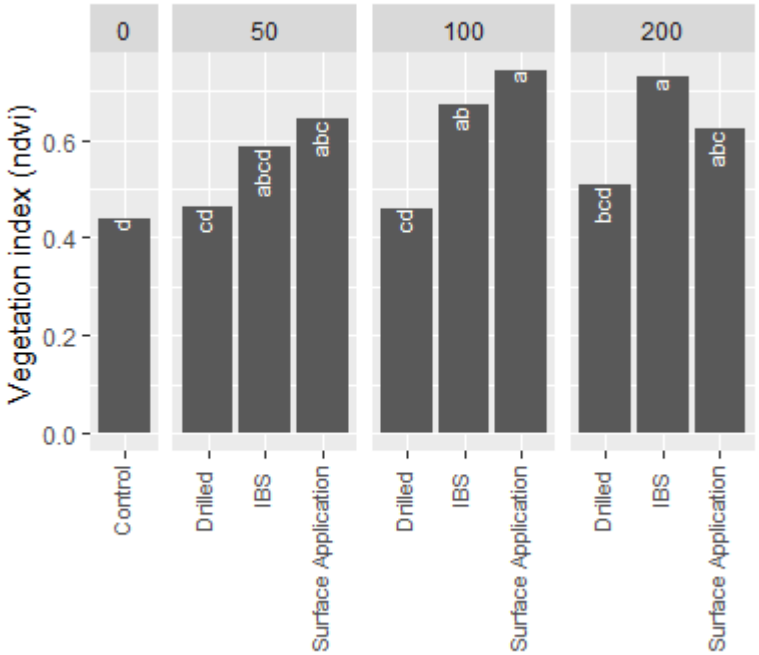

Figure 1. Vegetation index assessed 91 DAS for 4 nitrogen application rates (kg/ha)

Yield and grain quality: There was a clear response to both nitrogen placement and rate (Figure 2). Where 50 kg N/ha was applied broadcast treatment out yielded drilled treatment by 1.1 t/ha, and where 200 kg N/ha was applied the differences was more than 2 t/ha.

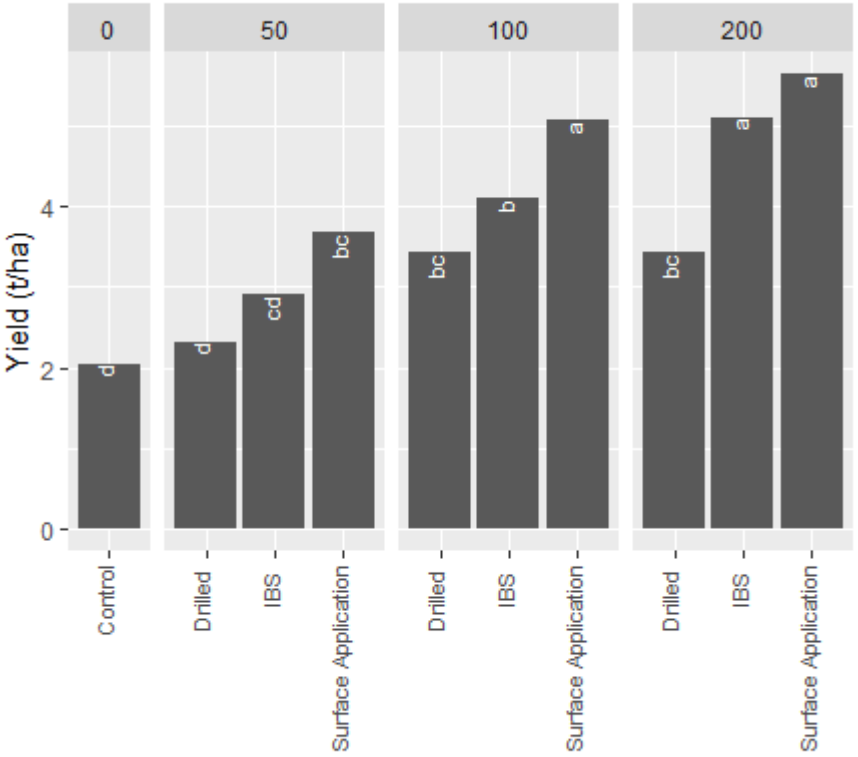

Figure 2. Wheat yield (t/ha) and grain quality for 3 application techniques and 4 rates.

Differences in grain quality were more related to fertiliser rates than timing, but there was a trend to higher protein and lower screenings as the nitrogen rate increased for both broadcast treatments. However there was no significant response for the drilled treatment (**Error! Reference source not found.**).

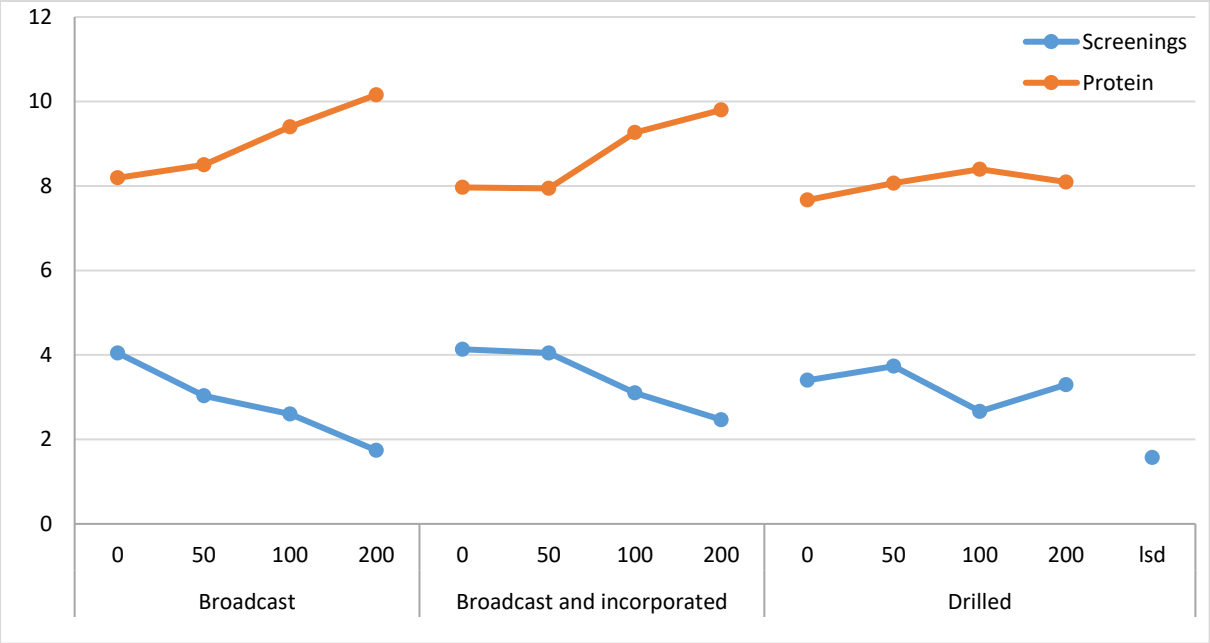

Figure 3. Wheat grain quality for 3 nitrogen application techniques and 4 application rates.

Discussion

There was a considerable response to placement of N fertiliser, with broadcast treatments having significantly higher yields and trending towards better grain quality. This was also reflected in crop growth. There are a couple of scenarios which could contribute to this result, Firstly, conditions at planting were very wet. It is possible (but unlikely) that some of the fertiliser drilled in was subjected to volatilisation, as it was placed at approximately 6 cm depth, 4 cm below the seed. Assessments of plant establishment did not detect and differences in establishment indicating that volatilisation did not adversely affect germination. However, the vegetation index did show treatment differences 91 DAS. The drilled urea may have caused some early root pruning limiting growth. It is also feasible that some of the fertiliser N was also lost to denitrification, concentrating nitrogen (in a band) coupled with warm, wet conditions are conducive to this loss pathway.

Yield response to nitrogen rate was also significant, with an almost linear yield response for both broadcast treatments. Addition of 100 kg N/ha more than doubled yield (Figure 4).

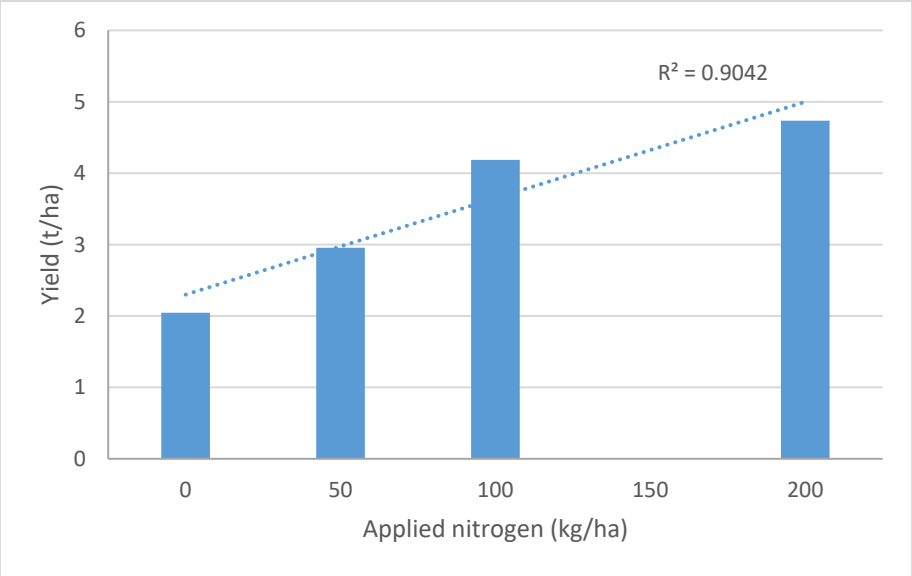

Figure 4. Wheat yield (averaged for all application methods) for the 4 rates.

There was a large difference in profitability between the various application techniques. conditions at sowing (and fertiliser application) were very wet. Broadcast application was far more profitable than other application methods (**Figure 5**). Where 50 kg N/ha was broadcast it was $140/ha and $185/ha more profitable than where the same amount was 'broadcast and incorporated' and drilled respectively.

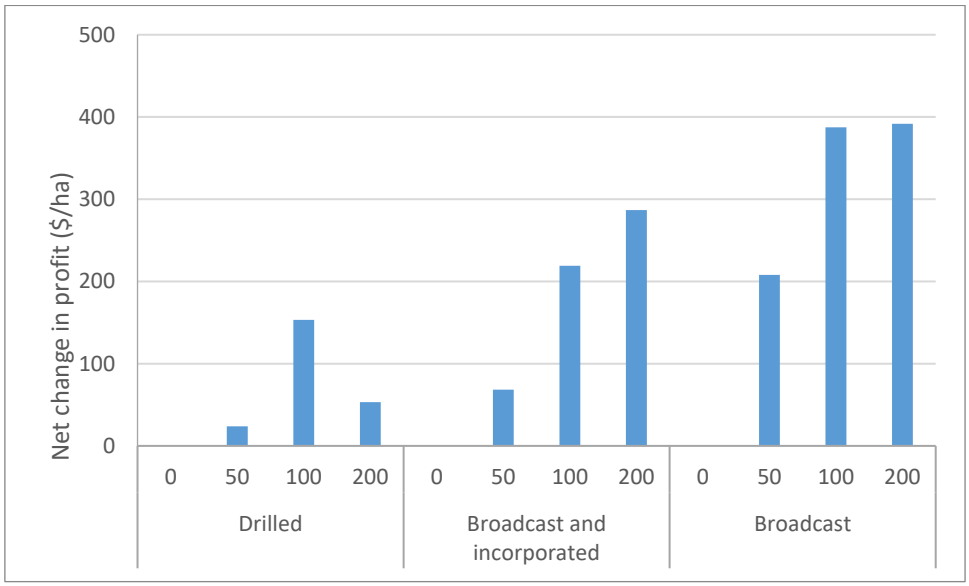

Figure 5. Differences in net profit compared to the no nitrogen treatments. Note: calculations do not include any costs associated with the spreading or incorporation of nitrogen.

Conclusion

Banding high rates of nitrogen at sowing is not recommended.

Broadcasting urea either just before (IBS) or just after sowing can be more profitable when compared to drilling under the seed.

Application of large rates of nitrogen can provide high levels of return on investment in favourable seasons.

Acknowledgements

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DISCLAIMER — TECHNICAL

Appendix -

N rate (kg/ha)	Application method	NDVI	Yield (t/ha)		Protein (%)		Screenings (%)
0	Broadcast	0.44	2.0	d	7.9	c	3.6
50	Drilled	0.46	2.3	d	8.1	bc	3.7
50	Broadcast and incorporated	0.59	2.9	cd	9.1	abc	3.1
50	Broadcast	0.64	3.7	bc	8.5	abc	3.0
100	Drilled	0.46	3.4	bc	8.5	abc	3.0
100	Broadcast and incorporated	0.67	4.1	b	9.3	ab	3.1
100	Broadcast	0.74	5.1	a	9.4	ab	2.6
200	Drilled	0.51	3.4	bc	8.0	bc	3.4
200	Broadcast and incorporated	0.73	5.1	a	9.8	a	2.5
200	Broadcast	0.62	5.6	a	9.7	a	2.6
	LSD	0.18	1.0		1.5		ns

Values are grouped by the letter (A, B, etc.) in the adjacent column, values within a group are not significantly different from one another. ^ The homogeneous group format can't be used because of the pattern of significant differences.