GOA Trial Site Report

Wheat – comparison of planting nitrogen application methods

Trial Code: GONU01117-5

Year: Summer 2016/17

Location: Forbes, NSW

Trial Partners: David Rogers

Keywords

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

Take home messages

Placement of urea below the wheat seed in heavy wet soils can impact on plant establishment and subsequent yields

Surface applications of urea, can perform as well or better than regardless of whether it is applied immediately before or just after sowing

Background

Changes in the regions farming systems is seeing increasing needs to apply nitrogen (N) to crops to optimise their performance. Farming systems are now requiring higher rates and more frequent N applications than in the past. This is adding additional workload. It is increasingly difficult to find enough time to apply N by traditional means which are often slower and more specific in their timings. Traditional methods of application include drilling N or broadcasting N only 1-3 days ahead of rain events, mostly in crop.

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, 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, which opens the windows for broadcast applications. But questions remain over whether it is not more efficient and safer to incorporate or bury applied urea to minimise volatilisation losses. Options tested to incorporate urea include drilling or banding it into the seed bed or alternatively incorporating urea by sowing (IBS) in the case of tyne planters.

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

Aim

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

Methods

A small plot trial was established at sowing and included treatments with the following N application timings.

Table 1. Treatment Details

Treatments	Description
Broadcast and incorporated	Urea was spread by hand and incorporated using a knife point press wheel seeder
Drilled	Urea was banded approximately 6-8 cm deep using a knife point press wheel seeder
Surface	Urea was broadcast by hand onto the soil surface (after the knife point press wheel seeder had passed through it)
Nitrogen rate	Applied as urea at 4 rates (0, 50, 100, and 200 kg N/ha) to each of the above application treatments

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 2. Trial site Details

Trial Establishment Date	Autumn 2016 – Nitrogen treatments applied at sowing		
Crop and Variety	Wheat - Gregory	Seeding rate	55 kg/ha
Sowing date	8/5/2017	Harvest date	24/11/2017
Seedling equipment	Double boot knife point press wheel	Row spacing	27.5 cm
Crop Nutrition (kg/ha)	150 triphos	Soil type	Self-mulching grey clay
Previous Crop	Canola	Pre-sowing stubble management	Ploughed and worked
Soil residual nutrition (at sowing)	Colwell P ~ 32 ppm, Sulphur ~ 7 ppm	Nitrogen	0-60cm ~ 95 kg/ha

For the purpose of analysis and discussion unless otherwise stated, treatments and their effects are compared to untreated control (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

Rainfall[1]: Fallow rainfall 175 mm (i.e. 1st February to sowing)

[1] Rainfall measured at site.

In-crop rainfall 189 mm (sowing till harvest)

Plant establishment: Nitrogen was applied at planting in the drilled treatment. It was placed 4-5 cm below the seed. This placement negatively impact establishment by 35% (**Figure 1**)

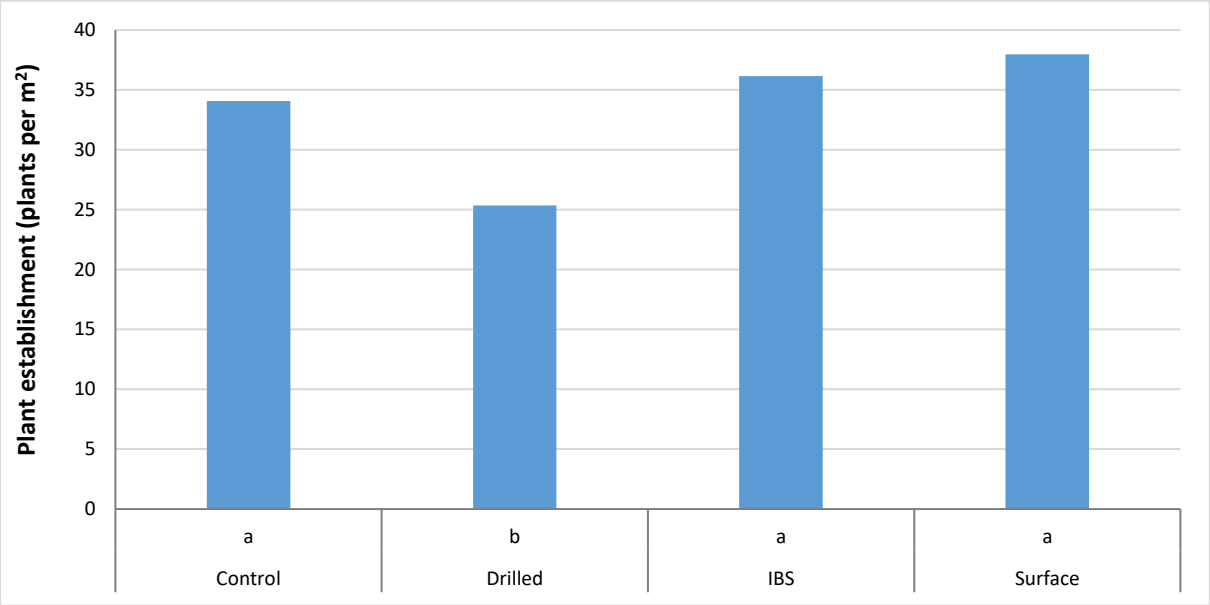

Figure 1. Plant establishment for the 3 application techniques (regardless of N rate) compared to the control. Data with the same letter are not significantly different.

Yield and grain quality: Both surface application treatments had higher yields than drilled treatment and control. The IBS treatment had slightly higher protein than the drilled or control treatment. There was no effect of placement on screenings (**Figure 2**.).

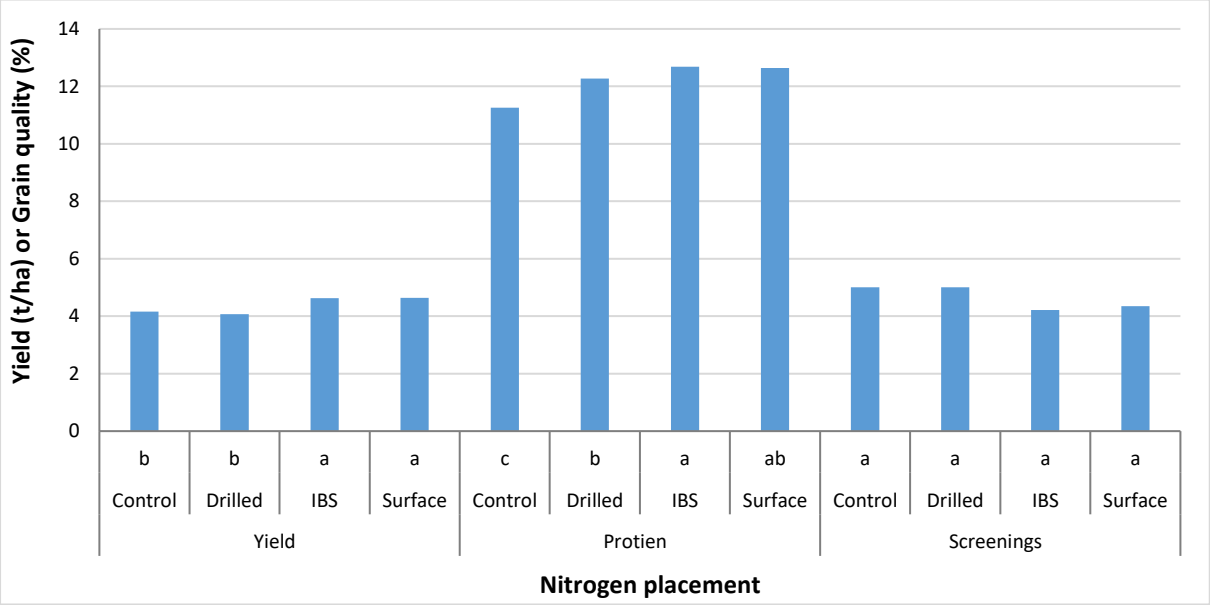

Figure 2. Wheat yield (t/ha) and grain quality for 3 application techniques regardless of N rate, compared to untreated control. Data within each variable with the same letter are not significantly different.

Yields increased by close to 0.2 t/ha with addition of 50 kg N/ha (Figure 3). Adding more nitrogen tended to not result in any further gain or loss in yield. There was also a positive protein response with

levels increasing from 11.3% to 12.8% from no N to 100 kg N/ha. Screenings decreased with increasing rates of N from 5.0% to 4.3% from no N to 100 kg N/ha (**Figure 3**).

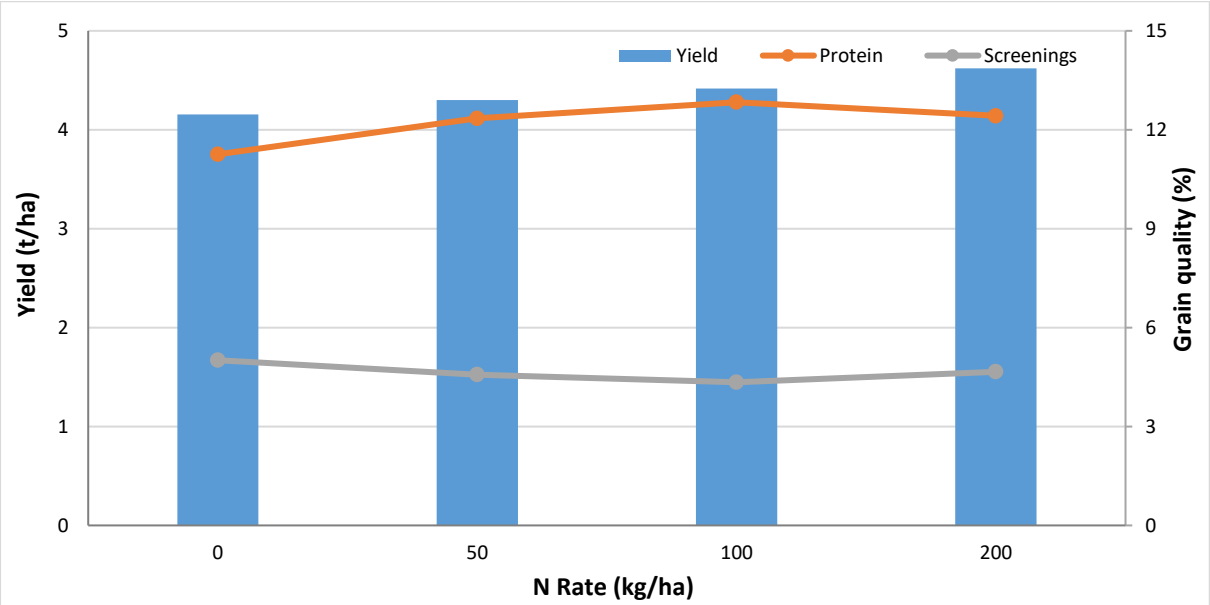

Figure 3. Wheat yield (t/ha) and quality by nitrogen rate (kg N/ha) for all application techniques. Data within each variable with the same letter are not significantly different.

Discussion

At this site treatments were applied at sowing. Drilled treatments were banded below the seed and although there was separation (about 4-5 cm) there was evidence that the plant establishment was reduced by 35% due to treatment effects. There is enough evidence warrant further investigation into effects of fertiliser on wheat establishment in heavier soil types.

There was only a modest yield response to nitrogen, the best treatments only managing a 10% increase over the no N control. Placement of the fertiliser did have an impact on yields and protein. Placement of N fertiliser on the soil surface at sowing, out yielded drilled treatment, which in turn was no different to not applying any fertiliser. It is likely that plant establishment effected yields of drilled treatments.

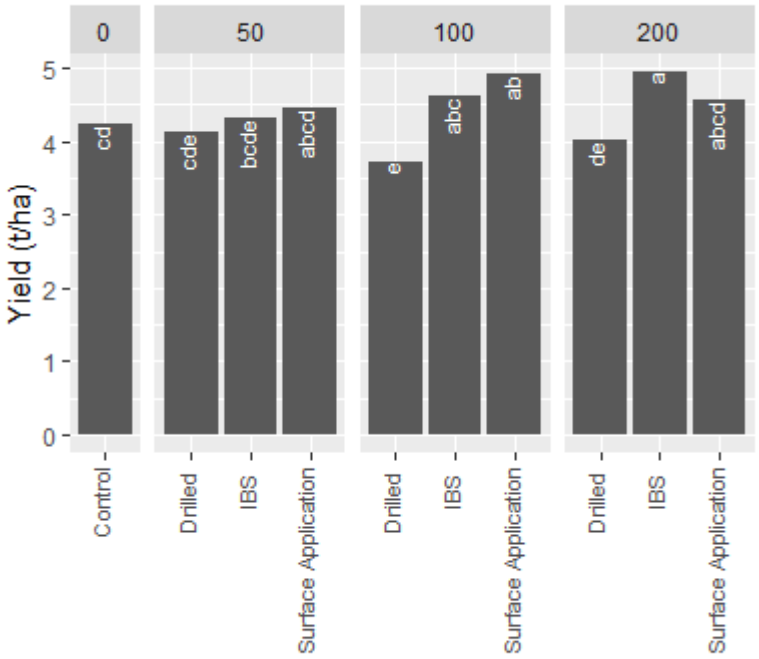

Figure 4. Wheat yield (t/ha) and quality by nitrogen rate (kg N/ha) and application method. Treatments with the same letter are not significantly different.

The original premise of this trial was to determine if spreading urea may reduce the incidence of denitrification losses that may occur from concentrating high N rates in a band as opposed to denitrification. Applying urea at sowing would also significantly reduce the risk of de-nitrification due to the cooler seasonal conditions (compared to a summer fallow application. This trial would suggest that there are issues with banding urea, however, in this case the problem is with plant establishment. It is unlikely that this would have occurred if nitrogen was applied in the fallow. It would also suggest that Placing the Urea away from the seed on the surface is a viable alternative to banding, and in this trail improved yield and grain protein levels.

High rates of nitrogen did not cause 'haying off' i.e. significant yield or quality loss. Grain quality tended to improve with increasing rates of nitrogen up to 100 kg/ha.

Conclusion

Placement of urea below the seed at sowing can negatively impact on germination and subsequent yields. Growers should be cautious about placing urea with or below wheat seed particularly in heavier wet soils.

Broadcasting urea before or after sowing is a viable alternative to introduce N into the system, as it did not impact on plant establishment and gave the best yields.

Acknowledgements

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DISCLAIMER — TECHNICAL

Appendix – Results table

N rate (kg/ha)	Application method	Yield (t/ha)		Protein %		Screenings %		Plant Establishment (m^2)	
0	Control	4.2	d	11.3	e	5.0	ns	34	ab
50	Drilled	4.1	de	12.3	d	4.6	ns	24	b
50	IBS	4.3	cd	12.4	cd	4.6	ns	31	ab
50	Surface	4.5	abcd	12.4	cd	4.5	ns	38	ab
100	Drilled	3.7	e	13.4	a	4.5	ns	27	ab
100	IBS	4.6	abc	12.7	bcd	4.1	ns	38	ab
100	Surface	4.9	ab	12.4	cd	4.4	ns	40	a
200	Drilled	4.4	bcd	11.1	e	5.9	ns	26	ab
200	IBS	4.9	a	13.0	abc	4.0	ns	40	a
200	Surface	4.6	abcd	13.2	ab	4.1	ns	36	ab
LSD		0.48		0.63		ns		14	

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