Nitrogen rate and timing at Frances

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Key Outcomes

- Grain yields of wheat were higher when additional nitrogen was applied at sowing compared to when applied at GS31
- Timing of nitrogen application is essential to maximise plant growth and achieve yield potential
- Grain protein was only higher when delayed nitrogen application was applied, which resulted in reduced wheat yield
- Starting soil moisture, paddock rotation history and potential yield of crop are important factors to consider when deciding amount of nitrogen to apply and timing

Trial Objectives: To assess the impact of applying additional nitrogen at different rates and timings on grain yield of wheat

Trial Duration: 2012

Location: Frances **Farmer Cooperators:** Chris & Tim Fry

Soil Type: Sandy loam over clay

Monthly Rainfall:

Rain	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	April-Oct	Total
Frances (NRM)	20	1.6	40	17	37	88	53	77	45	26	15	15.2	343	435

Paddock History: barley (2011)

Yield Limiting Factors: moisture stress after flowering

Plot Size: 1.6m x 8m (8 rows x 15cm spacings)

Replicates: 3

Trial Details

Table 1: Treatments applied at Frances nitrogen rate and timing trial in 2012.

Trial	**Nitrogen rate x Timing**	**GS31 top-dress timing**
Sowing date **Harvest date**	June 7 December 27	
Seeding rate	Bolac wheat @ 75 kg/ha	
Sowing fertiliser rate	18:13:0:10 @ 140 kg/ha	September 5
Nitrogen treatment	**Nil** **25 N** at sowing **75 N** at sowing **25 N** at GS31 **75 N** at GS31	**25 N** = 54 kg/ha Urea **75 N** = 163 kg/ha Urea

Trial Results

Nitrogen Rate x Timing

A significant nitrogen rate by timing interaction occurred for grain yield (Figure 1). Wheat yield was increased by 340 kg/ha by applying an extra 25 kg/ha nitrogen at seeding compared with the control (nil). This response was further increased when 75 kg/ha nitrogen rate yielded 720 kg/ha higher than the control (figure 1).

When the 25 kg/ha and 75 kg/ha rates were applied at GS31, the effect was substantially reduced. Cold conditions in winter resulted in slow crop growth, with wheat reaching GS31 around 5 September. This meant nitrogen applied at GS31 gave some response at the 75 kg/ha rate but not at the 25 kg/ha rate (figure 1).

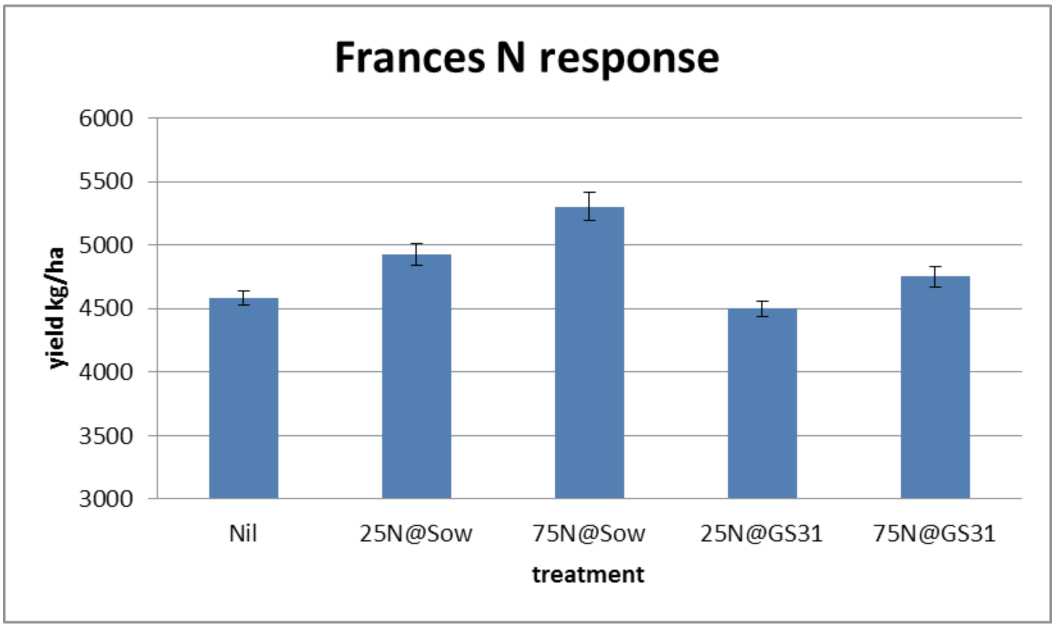

Figure 1: Yield of Bolac wheat at three fertiliser rates and two application timings, Frances 2012

Table 1: Total amount of nutrition applied to wheat at sowing and GS31 at Frances 2012

Treatment	N	P	K	S	Total N (rounded)
Nil	25.2	18.2	0	14	25
25 N at sowing	25	-	-	-	50
75 N at sowing	75	-	-	-	100
25 N at GS31	25	-	-	-	50 split application
75 N at GS31	75	-	-	-	100 split application

Grain Quality

The grain quality results showed a difference in protein when nitrogen was applied at 75 kg/ha at GS31. Likewise when no additional nitrogen was applied, the protein level was lowest (Table 2). Test weight results (hectolitre) were highest when additional nitrogen was applied at sowing, while nitrogen applied at 75 kg/ha at GS31 recorded the lowest test weight.

Table 2: Grain quality results for Bolac wheat, Frances nitrogen trial, 2012

Treatment	Hectolitre	Protein %
Nil	82.35 b	10.2 a
25N@Sow	82.83 c	10.5 b
75N@Sow	82.70 c	10.5 b
25N@GS31	82.77 c	10.5 b
75N@GS31	81.47 a	11.8 c
LSD	0.22	0.25

Comments

The crop was sown into cold soil conditions where growth was initially slow until early spring when longer days advanced development. Fertiliser applied at sowing is available to the crop when required. It appears that the application of additional nitrogen at GS31 was too late in 2012 for the crop to make best use of it, and so grain yield was reduced. This is a very similar result to a 2011 trial at Frances where additional nitrogen applied at sowing yielded higher than when applied at GS31.

At GS31 (Zadok's growth stage 31) the crop is stretching up and out and has a high demand for nitrogen, in proportion to available moisture. Immediately prior to this point, the plant is setting up yield potential based on available nitrogen (and moisture).

Generally for every tonne of wheat grown up to 3 t/ha, 20 kg of nitrogen is required. Thereafter, the requirement is around 15 kg/ha per tonne grown. Therefore a crop yielding 5 t/ha will have used ((3*20) + (2 * 15)) = 90 kg/ha nitrogen (sourced from various nitrogen pools). Despite a barley crop being grown in 2011, it is possible that the wheat finished on nitrogen stored in the profile that was mineralized during the 2012 growing season.

Bolac wheat has mid-late season maturity, and according to the rainfall chart for this site, the trial did not suffer from moisture stress until mid November when the crop was well into grain filling. At this stage the crop would have relied on stored moisture.

Nitrogen in the form of urea provides crops with a sudden burst of nitrogen. This is beneficial to crops depending on the crop type, season and growth stage. Nitrogen is partitioned to crops as yield first and protein second. When nitrogen is applied to a crop that is more advanced however, the crop is forced to partition this into protein, which is reflected in the 75 kg/ha rate at GS31.

Conclusion and into the paddock

Crops require nitrogen in different amounts and at different times as they grow and develop; therefore if sufficient nitrogen is unavailable when it is required, yield potential will be compromised. Farmers who choose to split nitrogen applications must correctly identifying GS31 by monitoring paddocks regularly to prevent crops from 'running out' of nitrogen before it can be applied. This can be a catch for growers with large operations where although timing is critical, prolonged wet conditions can prevent spreading.

Growers should consider starting soil moisture, paddock history and yield potential when deciding amounts of nitrogen to apply and timing.

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