Which N-based fertiliser is best when topdressing wheat?

The aim of this replicated trial was to compare three N products for topdressing nitrogen onto wheat.

Summary
Calculating N supply in a highly variable climate is a difficult task and delivering split applications is attractive when aiming to minimise the risk of over- or under-fertilising.

Nitrogen supply was not limiting to yield at this site. As a result the application of N, regardless of the product or the timing of application, achieved no yield benefit. The addition of N did however significantly increase grain protein – control 9.8% and the N treatments 11.5%. With a site average of 3.8 t/ha and a water use efficiency of 19-kg/mm/ha it is likely that moisture was more limiting than N.

In the northern Wimmera and southern Mallee N topdressing should only be considered when the crop has access to a wet soil profile.

Background
Fertilising to achieve adequate nitrogen nutrition is a difficult task in our highly variable rain-fed system. Applying split applications of N fertilisers is a strategy that may reduce the risk of over- or under-fertilising crops. Volatilisation, the loss of nitrogen to the atmosphere, can however undermine the efficiency of broadcasting nitrogenous fertilisers onto alkaline soils. This trial investigated which nitrogenous fertiliser was most efficient.

Methods
This trial was conducted using a fully replicated randomised block design.

A block of Yitpi wheat was dry sown at 86 kg/ha with 80 kg/ha of Mallee Mix 1 on 5 June.

The wheat was direct-drilled into field pea stubble that had been grazed but not cultivated. Pre- and post-emergent weed control was conducted with normal applications of registered products.

At the time of sowing 90 kg/ha of nitrate N was present in the soil profile (0-60cm).

Three different N-based products (Urea, Sulphate of Ammonia and Ammonium Nitrate) were applied at 37kg N/ha (see table 1) at two different crop stages (5-leaf stage and end of tillering). Rainfall occurred within 24 hours of each application.

All plots were harvested and grain was tested for yield, protein and screenings.

Table 1: Comparing the product analysis, cost per tonne and cost per hectare for Urea, Sulphate of Ammonia, Ammonium Nitrate.

Product	Analysis (N:P:K:S)	Cost ($/mt)	Cost ($/ha)
Urea	46 **:** 0 **:** 0 **:** 0	425	34
Sulphate of Ammonia	20.5 **:** 0 **:** 0 **:** 23.5	418	75
Ammonium Nitrate	34.5 **:** 0 **:** 0 **:** 0	414	44

Results
A total of 96 kg N/ha was available to the crop at sowing which is enough to produce a 4.0 t/ha wheat crop with 10 % grain protein (Table 2).

Nitrogen application, regardless of product and timing, did not have a significant effect on crop yield (Table 3). There was a significant effect of nitrogen application on grain protein with all N treatments being significantly higher than the control – average protein of N treatments was 11.5% and the control was 9.8 % (LSD 5% = 1.0). Within the N treatments the product type and application timing had no effect on grain protein.

The type of N product or application timing had no significant effect on screenings.

Table 2: Nitrogen budget – indicating total available nitrogen to the crop

Source of Nitrogen	**N kg/ha**
Stored N at Sowing	90
N sown as fertiliser	6
Total N available	**96**
Potential crop yield (N-based) with 10% protein*	**4.0**

* Grain N = 32 + 0.4 (Avail N at sowing), and
* Potential yield (t/ha) = Grain N / (Protein / 5.75) / 10

Table 3: Yield, grain quality and N utilised under each N fertiliser strategy.

Treatment	**Yield (t/ha)**	**Protein (%)**	**Screenings (%)**	**Grain N* (kg/ha)**
Control	3.9	9.8	4.8	69
Urea – 5 leaf	4.0	10.9	4.5	64
Sulp of Ammonia - 5 leaf	3.7	11.6	2.8	56
Amm. Nitrate- 5 leaf	3.8	11.6	2	58
Urea – End of tillering	3.8	11.4	2.5	57
Sulp of Ammonia - End tillering	3.8	11.8	3.5	58
Amm. Nitrate - End tillering	3.8	11.5	2	57
Significant Difference	**NS**	**P<0.01, LSD = 1.0**	**NS**	**-**

* Grain N = Yield (t/ha) x (Grain protein x 5.75) x 10

Interpretation
Available N at sowing was 96 kg/ha which is enough to grow a 4 t/ha crop at 10% protein.. At 3.9 t/ha with 9.8% protein the control plot produced 69 kg grain N/ha. Effectively the control grew as much yield as was possible with the N supplied and with a water use efficiency of 19.5-kg/mm/ha it indicates that N was not limiting yield. As a result, the additional application of N - regardless of the product or the timing of application - achieved no yield benefit, as these treatments were water limited not N limited.

The addition of N did however significantly increase grain protein – control 9.8% and the N treatments 11.5%. This is not unexpected because with water limiting yield the excess N was not able to be converted into yield and was channelled into grain protein.

If conditions are favourable early applications of N (5-leaf stage) are expected to contribute to yield by promoting more tiller production and hence setting a higher potential for the crop. Late application is expected to contribute to grain protein as excess nitrogen is not utilised for new growth but rather channelled into grain protein during grain-fill. At the Rupanyup site the crops were stressed for moisture during the early stages of development and the topdressing of N did not result in increased tiller growth and the extra N was used by the crop to produce more protein later in the season.

Commercial Practice

Calculating N budgets for target yields - based on paddock history and seasonal outlook – will assist with determining nitrogen requirements for each crop. Topdressing or split applications of N will minimise the risk of investing to heavily in nitrogen at sowing.

In the Wimmera to improve the yield potential of a crop, application of N must be made no later than late tillering (10 weeks after sowing). If the objective is to increase grain protein then the window of application is from late tillering to late stem elongation.

In the northern Wimmera and southern Mallee N topdressing should only be considered when the crop has access to a wet soil profile.

For further discussion of this topic refer to earlier editions of the BCG Crop and Pasture Production Manual.