Nitrogen management trial

As part of the Kangaroo Island GRDC funded stubble management project, more trial work was conducted in 2014 looking at nitrogen and sulphur management in wheat. The 8 treatments in the trial are defined in TABLE 1 below. Treatments are based on 150kg/ha of urea (70kg/ha of nitrogen).

The Trial was sown to a retained canola stubble, with the focus on managing nitrogen and sulphur nutrition with retained stubble.

TABLE 1: **Nitrogen treatments defined. Treatments are based on district practice of 70kg/ha of N or 150kg/ha urea**

Treatment/N rate	Treatment explained
Control (0kg/ha N)	No in-crop N fertiliser.
Biopolymer urea (70kg/ha N)	150kg/ha urea coated with biopolymer powder. All broadcast at start stem elongation 15th Aug.
eNtrench™ (70kg/ha N)	150kg/ha Urea plus Dow eNtrench™ N stabiliser applied with a flat fan nozzle at 2.5L/ha at mid tillering on 30th July.
ENTEC® (70kg/ha N)	150kg/ha Incitec Pivot ENTEC® N stabiliser coated urea applied at mid tillering 30th July.
Urea 150 Mid tillering (70kg/ha N)	150kg/ha urea applied at mid tillering on 30th July.
Urea 150 Split (70kg/ha N)	150kg/ha urea only, split application. First half at start of stem elongation 1st Aug, second half at flag leaf emergence 6th Sep.
Urea 400 (140kg/ha N)	300kg/ha urea split in 3 x 100kg/ha applications: start tillering 14th July, Start stem elongation 15th Aug, & Flag emergence 8th Sep. *Note final 100kg/ha application at flowering was abandoned due to lack of moisture, absence of forecast rainfall, hence only 300kg/ha of the intended 400 was applied.*
Urea AMS blend (70kg/ha N) (10kg/ha S)	135kg/ha urea blended with 40kg/ha ammonium sulphate applied at start of stem elongation 15th Aug.

The trial was a completely randomised block design with 4 replicates. This means that each nitrogen treatment appeared 4 times in the trial, once in each of the four blocks. Each plot was 8m long by 3m wide.

Agronomy and site conditions

The selected site at "Jenkins" block run by S & W Veitch on Margries Road, was a well-drained duplex soil. The soil was a fertile sandy loam with Colwell phosphorous of 104mg/kg, sulphur of 16mg/kg, and potassium of 234mg/kg, making phosphorus and potassium levels high and sulphur adequate. Soil pH ($CaCl_2$) was 4.3 which is acidic.

Agronomy was typical of Kangaroo Island, continually cropped paddocks and was the same for all treatments with the exception of in-crop nitrogen. The trial was sown to 100kg/ha of 'Scout' bread wheat with 90kg/ha DAP on the 5th June. The paddock had previously grown canola in 2013, and broad beans in 2012. Trace elements were applied as foliar spray on 22nd of July and included 400ml/ha zinc oxide, 500ml/ha manganese oxide, 250ml/ha copper oxide and 10g/ha molybdenum.

The trial received only 405mm of rain in an area with a rainfall average of 600mm. The site is well drained and the trial was not waterlogged.

Summary of new products

The following are the trial manager's interpretations of the manufacturer's information provided about the new products.

Biopolymer Urea

This product claims to contain negatively charged silica particles which bind to the urea. This is supposed to stabilise the urea enabling slow release into the soil and also reduce evaporation (volatilisation).

eNtrench™

This product is a nitrification inhibitor designed to be sprayed on soil at time of urea application. It reduces the bacterial conversion of ammonium N to nitrate N. Ammonium N is a more stable form of N. This results in less N loss from soil and potentially an increase in urea efficiency.

ENTEC®

Nitrification inhibitor that is purchased pre-coated onto N fertiliser. It reduces the conversion ammonium N to nitrate N by inhibiting the bacteria responsible. This results in less N loss from leaching and denitrification.

Both eNtrench™ and ENTEC® inhibits the same process but contain different active ingredients.

Results

TABLE 2: **Effect of N treatment on grain quality and classification**

Treatment	Average yield t/ha	Test weight g/hL	Screening %	Protein %	Classification
Biopolymer	4.08	81.4	2.89	11.8	H2
Control	4.01	83	1.49	10.1	APW2
ENTEC®	4.24	80.4	2.56	11.9	H2
eNtrench™	4.18	80	2.3	11.8	H2
Urea 150 GS31	4.28	81	2.13	11.7	H2
Urea 150 Mid Till	4.22	80.8	2.8	11.9	H2
Urea 400	4.02	77.6	3.96	12.3	H2
Urea/SOA GS31	4.24	81	2.35	11.9	H2

Grain quality

Grain quality results are not replicated and hence we have no statistics to support them. From previous N trial work and replicated quality data (2012), caution should be taken when comparing differences in protein of less than 1%. For example, protein differences between all the treatments resulting in protein of around 12% would not statistically have a significant difference from one another. However, the control, at just over 10% protein is likely to be statistically, significantly lower.

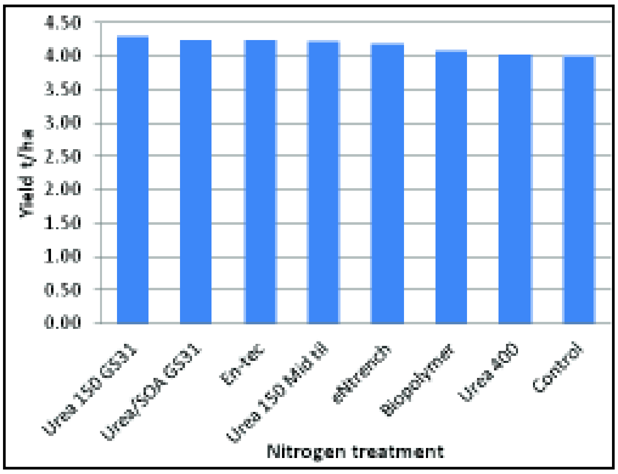
Screening portions that differ by more than 1% are also likely to be statistically significant. The control plot had lower screenings, possibly indicating less crop canopy at grain fill and less moisture stress under very dry conditions.

Previous work with replicated test weight data, indicates more variation than screenings and protein. Hence, we can only suggest that the control treatment produced the highest test weight, Urea 400 treatment the lowest and the remaining 70kg/ha N treatments somewhere in between. This is what we would anticipate from the interaction of moisture stress at grain fill with different canopy sizes from varied N nutrition.

Grain Yield

From FIGURE 1 it can be seen that there are very small differences in yield. The 5% L.S.D. is 0.41 tonne/ha. This means that for the treatments that have yields that differ by more than 0.41 tonne, we are 95% confident that the true yields would differ again if the treatments were applied at the same site under the same seasonal conditions. No yields differ by this amount and hence there are no statistically significant differences in yield

FIGURE 1: **Graphical comparison of the effect of Nitrogen treatment on grain yield.**



at the 95% confidence level. This makes it difficult to evaluate ENTEC®, eNtrench™ and Biopolymer urea coat products.

The Coefficient of Variation for the trial is 6.7%. This indicates that the results are reliable.

We could draw the conclusion that this site in the 2014 growing season was not very responsive to N treatment. The most likely explanation could be moisture stress at grain fill due to poor spring rains (29mm for Sep, 2mm for Oct and 0mm for Nov). Extra growth from N fertiliser would increase the crop water requirement, increasing stress and reducing yield potential. It could also be possible that soil N was not limiting at this site. This is less likely as there were visual biomass responses to N. Unfortunately the budget did not cover deep soil N testing to further investigate this. For the mentioned reasons it would be unreasonable to expect the same N response (or lack thereof) in a different paddock and different season. For example, 2013 trial work on the Island indicated up to 1t/ha yield above the control for some N treatments

TABLE 3: **The effect of N treatment on yield as percentage of control over two different seasons**

Treatment	2014	2013
Control	100	100
Urea 150kg/ha#	107	112
Urea 400 kg/ha*	100	109

 # 150kg/ha urea treatment all applied at GS 31 in 2014 but split mid tillering and GS 31 in 2013.

** Urea 400kg/ha was applied in 2013 but on 300kg/ha in 2014 due to dry conditions at flowering.*

The N trial has now been held on the same property (different paddocks) for two years. It is interesting when we compare the yield results over the two years. 2013 was one of the wettest springs on record and 2014 one of the driest. In both years the 150kg/ha N treatment yielded better than the Urea 400 treatment (but this was not statistically significant in either year). This suggests that there is something other than N limiting yield for the Urea 150 treatment. The Urea 400 treatment cost extra and produced lesser yields in both seasons.

Gross Margin

TABLE 4: **The effect of N treatment on gross margin**

Treatment	Gross grain income $/ha*	N fert cost $ per ha	Gross margin $/ha^
Biopolymer	$958	$90	$468
Control	$943	$0	$543
ENTEC®	$995	$101	$495
eNtrench™	$982	$100	$482
Urea 150 GS31	$1,007	$75	$532
Urea 150 Mid till	$992	$75	$517
Urea 400	$944	$150	$394
Urea/SOA GS31	$997	$84	$514

^ *Assumes cost of growing wheat crop is $400/ha excluding any in-crop N.*

* *Gross income based on $235/t for all grades of wheat on farm. Calculated using KIPG estimated pool return per tonne for all grades of $260 less $15 storage and handling less $10 freight to silo.*

Due to the large feed grain requirement on Kangaroo Island for 2013, KIPG estimated pool returns are a flat rate over all classifications for wheat. This had limited impact on gross margin as all N treatments were classified as H2 except the control (refer TABLE 2 for more details).

Interestingly, the highest gross margin was for the control as this treatment produced only a marginally lower yield but had no N fertiliser cost. The Urea 400 treatment produced the lowest gross margin. The ENTEC®, eNtrench™ and Biopolymer treatments had lower gross margins than the Urea 150 treatments applied at the same time due to their higher cost and similar yield. Because there are only small differences in grain yield, gross margin was negatively correlated with N fertiliser cost per ha (more dollars spent on fertiliser results in a lower gross margin).

This gross margin data refers to this site and the 2014 season and we must consider the conditions as discussed in the yield and grain quality results. For these reasons it would not be appropriate to conclude that applying no in-crop N would maximise gross margin in 19 out of 20 years.

Tiller density

TABLE 5: **The effect of N treatment on tiller density as a percentage of the control for 2014 N trial.**

Treatment	Tiller density % of control
Control	100
Urea 400	112
Urea 150 GS 31	112
Urea 150 Mid till	102

If we compare the Urea 150kg/ha treatment applied mid tillering to the control (no in-crop N) we get a 2% increase in tiller density. This is not likely to be statistically significant due to the large variation in the primary data. If we compare Urea 150kg/ha GS 31 (all in-crop N at start stem elongation) to the Urea 400 treatment (100kg/ha urea applied at start of tillering) we see no difference in tiller density. This suggests that early applications of N did not influence tillering at this site in the 2014 season. Similar results have been observed in the 2013 N trial with high N rates during tillering not increasing tiller density.

Take home messages

- Small differences in yield with extra N under conditions at this site.
- Very dry spring needs to be taken into consideration when interpreting results.
- High rates of N early did not have significant impact on number of tillers.
- Grain quality higher for all N treatments.
- Further work required with ENTEC®, eNtrench™ and Biopolymer urea coated product.

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