Nitrogen management trial

Background

Previous nitrogen trial work on Kangaroo Island has looked at the interaction between N and waterlogging. Most of the trial work done under extreme waterlogged conditions has suggested little benefit in applying high rates of N or the more expensive N products in terms of yield and gross margin.

This year's trial looks at different Nitrogen rates, timings and products under well drained conditions.

What was done

The eight treatments in the trial are described in TABLE 1 below. Treatments are based on 150kg/ha of Urea (70kg/ha of Nitrogen).

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 was typical of Kangaroo Island continually cropped paddocks and was the same for all treatments with the exception of in-crop nitrogen.

- Knockdown Glyphosate and Sakura 26th May
- Scout wheat sown on 2nd June at 100kg/ha with 90kg/ha MES 10 fert
- 100kg/ha Urea applied on 2nd Aug
- 50kg/ha Urea applied on 17th Aug
- Mn, Zn, Cu and Mo applied 11th Sep
- Tebuconazole applied at 290ml/ha 11th Sep
- 60kg/ha AMS applied 12th Sep.

Previous crops in the rotation were: canola (2012), and lupins (2011).

The selected site was at Jenkins Block leased by S & W Veitch on Margries Road. It is a well-drained duplex soil. The soil is a fertile sandy loam with Colwell Phosphorus of 75mg/kg, Sulphur of 11mg/kg, and Potassium of 136mg/kg. These results indicate that Phosphorus and Potassium levels were high and Sulphur was marginal. Soil pH ($CaCl_2$) was 4.4 which is very low.

The trial received 704mm of rain for 2013 compared to the average of 600mm. The trial did not get waterlogged for any length of time.

Summary of 'New' products

The following is a summary of the new products applied in the trial. It is the trial manager's interpretation of the literature provided to them by the manufacturer and not necessarily the trial manager's opinion or beliefs nor those of the manufacturer.

Agrocote

Agrocote is a polymer coated Nitrogen and Sulphur fertiliser. It contains elemental S and Urea as its source of N. Its polymer coating allows constant release under moist conditions and N release is not soil temperature dependent. Nitrogen is released over a period of 4 months. The product must be pre-drilled as it will dry out if left on the surface, thereby impairing N release.

Perlka

Perlka is calcium cyanamide fertiliser. It functions as a soil sanitiser and a slow release N fertiliser. Nitrogen is released over a period of 4 to 6 weeks. It is not a true slow release N fertiliser like coated products such as Agrocote. It is in the trial due to its potential to kill pests - slugs in particular. The product is designed for short growing cycle horticultural crops.

TABLE 1. **Nitrogen treatments defined**

Treatment/N rate	Treatment explained
Control (0kg/ha N)	No in crop N fertiliser
Agrocote (70kg/ha N) (23kg/ha S)	175kg/ha of Agrocote slow release polymer coated fertiliser (38% N and 13% S), pre-drilled prior to sowing. Sulphur is elemental.
Biopolymer Urea (70kg/ha N)	150kg/ha Urea coated with biopolymer powder. All broadcast at start stem elongation- 1st Aug.
Urea 150 (70kg/ha N)	150kg/ha Urea split. The first half start stem elongation 1st Aug. The second half at flag leaf emergence 6th Sep.
Urea 400 (184kg/ha N)	400kg/ha Urea split in 4 lots of 100kg/ha applications, at start tillering 4th July, start stem elongation 1st Aug, flag emergence 6th Sep, and flowering 1st Oct.
Urea AMS blend (70kg/ha N) (23kg/ha S)	Urea and Ammonium Sulphate blend to give same total N and S as 'Agrocote' treatment applied 1st Aug at the start of stem elongation.
Perlka (70kg/ha N)	350kg/ha Perlka soil sanitiser and N fertiliser broadcast on 15th of May prior to sowing.
Twin N (0kg/ha N)	Free living soil N fixing bacteria, applied at rate of one vial per hectare to soil surface with streaming nozzles at start of tillering on 4th July.

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 volatilisation.

Twin N

Twin N claims to be free living Nitrogen fixing bacteria. The product comes freeze-dried in a vial and is applied at a rate of a few grams per hectare and hence contains no tangible quantity of N.

Results

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

Treatment	Protein (%)	Test weight (g/hl)	Screenings (%)	Staining (%)*	Classification
Agrocote	11	82.8	2.3	<5	APW1
Biopolymer Urea	11.6	81	2.2	15	H2
Control	11.2	81.6	2.16	34	APW1
Perlka	11.1	83.4	2.26	26	APW1
Twin N	10.9	83.2	2.6	<5	APW1
Urea 150	11.9	82.8	2.4	<5	H2
Urea 400	13.3	81.8	2.5	<5	H1
Urea AMS blend	11.7	81.4	2.5	17	H2

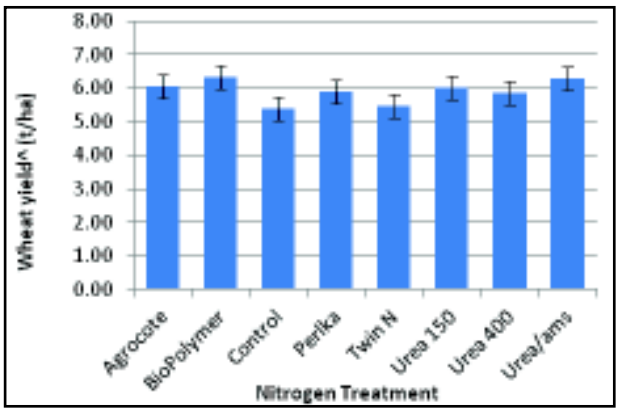
* *Please note that staining has been omitted from the classification calculation. The trial was sown to Scout wheat which is prone to staining. This can be seen in this year's wheat variety trial results where Scout had the highest percentage of stained grain (18%). This is much higher than the other varieties which typically ranged from 0 to 5%. As the nitrogen and variety trials were in the same paddock it could be assumed that if an alternative to Scout was grown in the N trial staining would have been low. It is also assumed that this alternative variety would have a similar response to N treatment as Scout has in this trial.*

Grain quality results were not replicated and hence we have no statistics to support them. From previous N trial work with replicated grain quality data, caution should be taken when comparing differences in protein of less than 1%, the same applies for screenings. In last years replicated trials, test weight had little variation.

Grain protein increased with increased N applied, a relationship not shared with yield. Test weights were high and screenings low; both appeared to be unaffected by nitrogen treatment. Urea 400 had high protein resulting in H1 classification.

Yield data is replicated; the 5% L.S.D is 0.35 tonne. This means that for the treatments that have yields

FIGURE 1: **The effect of in-crop N treatment on yield of Scout wheat.**



that differ by more than 0.35 tonne we are 95% confident that the true yields would differ if the treatments were applied again at the same site under the same seasonal conditions.

TABLE 3 summarises the statistically significant yield differences. All varieties are listed across the top in bold. Each variety yielded statistically significantly higher than all of the varieties listed in italics below it. For example Urea 150 yielded statistically significantly higher than Twin N and Control treatments only.

TABLE 3. **Summary of statistically significant differences at 95% confidence level.**

Bio Poly	Urea AMS	Agrocote	Urea 150	Perlka	Urea 400	Twin N	Control
Perlka	*Perlka*	*Twin N*	*Twin N*	*Twin N*	*Twin N*		
Urea 400	*Urea 400*	*Control*	*Control*	*Control*	*Control*		
Twin N	*Twin N*						
Control	*Control*						

Yields for all treatments were high for wheat on Kangaroo Island. From the lowest yielding treatment, the control, to the highest yielding Biopolymer Urea treatment, there was approximately 1t/ha difference.

The Urea 400 treatment did not perform as well as the Urea 150 treatment. This is surprising, as we would assume that 400kg/ha of Urea split in 4 applications would eliminate any N deficiency. This poor performance of a high N treatment was also seen in the 2012 N trial where 200kg/ha Urea was applied and compared to the standard 100kg/ha Urea -3t/ha vs 3.4t/ha (difference not statistically significant). At the time we dismissed this as a poor finish to the season due to below average spring rainfall, combined with a bulkier canopy. But 2013 had a very good spring, and the grain quality data shows low screenings and good test weight for the Urea 400 treatment, indicating minimal stress at grain fill. The poor performance and high cost question the merit of this treatment.

The Biopolymer treatment (of 150kg/ha Urea coated in biopolymer) was the highest yielding treatment. However, it was not statistically significantly higher than the Urea 150 treatment (150kg/ha plain Urea).

When we make the comparison between Biopolymer and Urea 150 treatments, they contain the same units of N, but there is a difference in timing. Biopolymer was applied at start of stem elongation, Urea 150 was split, half at stem elongation and half at flag leaf. Hence we have no true control for the biopolymer coating on the Urea. That is, we do not know if it was the Urea applied at stem elongation or the biopolymer additive that resulted in the higher average yield. But further work needs to be done with this biopolymer product and similar low cost products designed to increase N fertiliser efficiency.

The Twin N treatment did not perform statistically significantly better than the control. Whilst this product at $28 per ha is cheaper than 100kg/ha Urea, this money may be better spent on additional fertiliser.

The Agrocote treatment performed similarly to the Urea 150 treatment. Both treatments provided 70kg/ha of N. Agrocote may be able to provide an alternative to in-crop N application, but cost is an issue at $280/ha vs Urea at $90/ha. It may be an option where applying Nitrogen in-crop is not possible.

The Urea AMS (Ammonium Sulphate) treatment was the second highest yielding treatment in the trial. It was higher than, but not statistically significantly different to, Urea 150. This could suggest that there is a response to Sulphur- the crop was visually diagnosed as deficient at the end of August. If we compare Biopolymer and Urea AMS treatments to the Urea 150 treatment, they all have the same N (70kg/ha). Biopolymer and Urea AMS treatments both had all their Nitrogen applied at the start of stem elongation whilst Urea 150 was split. The earlier timing could have increased yield.

One would consider the yields of Twin N and control treatments to be high given that neither provided any in-crop N, except for when the whole trial received 60kg/ha AMS on 12th September. This was in addition to the N in the MES10 at sowing (total 23kg/N/ha). The trial was sown on the best part of a high yielding paddock. The results should not be interpreted that 5t wheat crops can be grown without in-crop N. It is the yield comparisons that are important.

For further information contact

Keith Bolto on 0427 311754 or email keith.erica@bigpond.com
Lyn Dohle on 0419846204 or email lyn.dohle@sa.gov.au

Economic analysis

As some of the products used in this trial are very expensive, yield comparisons do not give a good indication of economics. Gross margins are a better comparison and can be seen in TABLE 4. Urea 150, Urea AMS and Biopolymer Urea were the best performers. Urea 400 produced high quality grain but the cost and lower yield meant this did not translate to a high relative gross margin.

The Perlka treatment did not perform well. From TABLE 4 it can be seen that it had the poorest gross margin. This is a result of the extremely high costs of the product. Perlka is a horticultural product and has other benefits such as killing pests. There was no pest pressure in this trial.

TABLE 4. **The effect of N treatment on yield, cost of treatment and gross margin.**

Treatment	Yield (t/ha)	N fertiliser cost ($/ha)	Gross margin ($/ha)*
Agrocote	6.05	280	518
Biopolymer Urea	6.32	105	810
Control	5.37	0	664
Perlka	5.89	571	197
Twin N	5.48	28	657
Urea 150	6.02	90	762
Urea 400	5.85	240	577
Urea AMS	6.27	112	793

* *Gross margin calculation assumes cost of growing wheat crop excluding N fertiliser is $400 per ha.*

Take home messages

- Products with low cost per unit N were the most profitable in 2013.
- Very high N treatment increased quality but reduced yield.
- Some products that claim to increase N efficiency require further investigation.

Funding/Sponsors/Acknowledgment

- GRDC funding administerd by AgKI.
- S & W Veitch for providing trial site.
- KIPG for performing grain quality tests.
- Fertiliser companies for providing product.
- Andrew Ware (SARDI) for statistical analysis.