Nitrogen and phosphorus fertiliser additives and replacement products

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Key findings

- For all treatments grain yield or quality was not increased compared to conventional fertiliser applications of 80 kg/ha urea alone or 60 kg/ha urea plus 50 kg/ha DAP.
- Treatments selected for nitrogen and phosphorus tissue tests showed no difference in nutrient concentrations.

Why do the trial?

To investigate conventional phosphorus fertilisers and alternative sources of phosphorus on the grain yield and quality of wheat.

How was it done?

Plot size	1.4 m x 10 m	**Fertiliser**	Nitrogen and phosphorus applied as per treatment listed in Table 1.
Seeding date	7th June 2013	**Variety**	Emu Rock wheat @ 70 kg/ha

Methods

Conventional fertiliser treatments included urea only and urea plus DAP (18:20). The remaining fertiliser treatments were selected based on their suggested ability to improve plant uptake of nitrogen and phosphorus or as a direct nutrient input (Table 1).

The initial Colwell soil phosphorus (30th May 2013) was 59 mg/kg and DGT-P of 89 µg/L in the top 0 -10 cm. Both phosphorus tests indicate the trial site was above critical limit for yield response.

The phosphorus buffering index (PBI) was 102. Soil available sulphur was measured using KCl at 40°C and measured as 1.6 mg/kg which is below the critical limit for this test of 6.5 mg/kg.

Soil nitrogen level measured for this trial was 65 kg N/ha (0-90 cm), sampled 30th May, 2013.

Tissue phosphorus and nitrogen were assessed for specific treatments by removing youngest emerging leaf blade (18/9/13), oven drying and analysed by Waite Analytical Services.

Plots were assessed each year for grain yield, protein, test weight and screenings (2 mm screen).

Table 1. Summary of products trialed, whether they were used as a fertiliser addition or replacement and the main mode of action/purpose for the use in the trial at Hart in 2013.

	Treatment	Fertiliser addition or replacement	Reason for addition
1	80 kg/ha urea ONLY		Standard grower practice
2	60 kg/ha urea + 50 kg/ha DAP		Standard grower practice
3	80 kg/ha urea + 15 kg S/ha (as gypsum)	Addition	Sulphur addition
4	80 kg/ha urea + 30 kg S/ha (as gypsum)	Addition	Sulphur addition
5	73 kg urea + 15 kg S/ha (as SOA)	Addition	Sulphur addition
6	66 kg urea + 30 kg S/ha (as SOA)	Addition	Sulphur addition
7	Urea with Entec @ 80 kg/ha	Replacement	Ammonium stabiliser to limit nitrogen losses
8	60 kg urea + R.U.M – 5 L/ha @ mid-tillering	Addition	Foliar nitrogen (plus other nutrients)
9	60 kg urea + 50 kg DAP + Super Strike	Addition	Phosphorus (plus other nutrients) seed treatment
10	60 kg urea + 50 kg DAP + Jump Start	Addition	Phosphate inoculant that releases 'bound' soil P.
11	60 kg urea + 50 kg DAP + Balance & Grow 2L/ha	Addition	Foliar growth nutrient
12	Bounce Back @ 150 kg/ha	Replacement	Organic fertiliser (3:2:2 N:P:K) and other nutrients
13	60 kg/ha urea + 50 kg/ha DAP + 50 kg/ha biochar	Addition	Soil amendment
14	Biochar Complete @ 150 kg/ha	Replacement	Biochar blended with poultry litter
15	80 kg urea +Entrench– 2.5 L/ha @ 2-3 leaf	Addition	Nitrogen stabiliser
16	80 kg urea + Entrench – 2.5 L/ha @ GS31	Addition	Nitrogen stabiliser

Results

Results for tissue nitrogen ranged from 3.3% - 3.8%. The addition of sulphate of ammonia, Entec urea or eNtrench did not significantly increase tissue nitrogen concentration compared to an application of 80 kg/ha urea (Table 2). The same conclusion was drawn from tissue phosphorus concentrations. The addition of Superstrike and Jumpstart did not increase tissue phosphorus when added to urea plus DAP. Biochar complete maintained a tissue phosphorus concentration similar to urea plus DAP. However, given the initial soil phosphorus test was above the critical limit for growth response, soil phosphorus reserves were adequate for plant growth without additional fertiliser.

Table 2. Nitrogen and phosphorus leaf tissue concentrations for selected fertiliser treatments.

Treatment	Nitrogen %	Phosphorus mg/kg
1. Urea	3.3	
4. Gypsum high	3.5	
7. Entec urea	3.7	
15. eNtrench time 1	3.8	
16. eNtrench time 2	3.4	
2. Urea + DAP		3267
9. SuperStrike		3200
10. Jumpstart		3133
14. Biochar complete		3167
LSD (P≤0.05)	ns	ns

Grain yield and quality were not significantly improved for any treatment compared to urea only or urea plus DAP, yielding 3.88 t/ha and 4.22 t/ha, respectively (Table 3). Nitrogen products selected (slow release nitrogen, nitrification inhibitors and foliar additions) did not significantly alter grain yield or protein.

The addition of sulphur though applications of gypsum and sulphate of ammonia did not improve grain yield or quality, indicating adequate soil sulphur levels in this trial.

The initial soil phosphorus level was above the critical limit so it is unlikely that any products would result in a yield response, as observed in this trial. A previous phosphorus rate trial at Hart showed it took five years to run down soil phosphorus reserves before a yield response to phosphorus fertiliser was observed. These results highlight the importance of soil testing as fertiliser will provide a portion of the phosphorus for plant uptake with the majority coming from soil reserves.

Table 3. Grain yield (t/ha), screenings (%), protein (%) and test weight (kg/hL) at Hart in 2013.

Treatment	Yield (t/ha)	Screenings (%)	Protein (%)	Test wt (kg/hL)
1 Urea	3.88	8.6	10.5	82.6
2 Urea +DAP	4.26	8.1	10.5	82.7
3 Gypsum low	4.24	7.1	11.2	82.6
4 Gypsum high	4.01	8.6	10.4	82.8
5 SOA low	3.99	7.6	9.8	83.3
6 SOA medium	4.41	7.7	10.3	83.1
7 Entec urea	4.53	8.2	10.8	82.5
8 Beaulieu R.U.M	4.14	7.1	11.4	82.3
9 SuperStrike	4.29	8.1	10.3	83.0
10 Jumpstart	4.27	7.6	10.5	82.7
11 Balance and Grow	4.15	7.1	12.8	82.3
12 Bounce Back	3.90	7.8	10.0	82.8
13 Biochar	3.80	8.1	9.8	82.8
14 Biochar complete	3.87	7.8	10.7	82.7
15 eNtrench time 1	4.17	7.6	11.2	82.3
16 eNtrench time 2	4.11	7.5	10.7	82.5
LSD (P≤0.05)	ns	ns	ns	ns