3.4.6 Investigation of the benefits of specialty phosphorus products and liquid phosphorus options in cereals, Mininera, Vic

Location:
Mininera Research Site.

Funding:
Incitec Pivot Ltd. & Southern Farming Systems Streatham Branch.

Researchers/Authors:
Rob Christie & Charlie Walker, Incitec Pivot , and Peter Howie, School of Agriculture and Food Systems, The University of Melbourne.

Background/Aim:
The 1990's saw high growth rates in the use of micro nutrients in broad-acre crops in southern Australia. The driver of this growth has been better rotations leading to the cultivation of more sensitive crops. This has been coupled with the advent of break crops, cheap sulfonyl urea herbicides & increased use of soil ameliorants (lime, gypsum) which have simultaneously increased yield potential and changed soil chemistry. The combined effects of these factors has been increased demand on soil zinc and sulphur reserves with the emergence of responses across a larger area than usually expected. The continued use of high analysis phosphorus (P) fertilisers and the reduction of canola in some cropping rotations have also led to a reduction in sulphur inputs which in some cases may be leading to borderline soil sulphur levels.

Recent sharp rises in the cost of nutrient inputs combined with a run of poor seasons in much of the cropping belt has generated interest in alternative means of delivering P to crops such as liquids. Research on the Eyre Peninsula in recent years has demonstrated the benefits of fluid P fertilisers over granular forms on highly alkaline calcareous clays. Trials in the Wimmera, Mallee and North East of Victoria have at times demonstrated some benefits of fluids over granules on a variety of soil types albeit with advantages of generally lower magnitude. Cost increases have also sparked interest in additives that can potentially improve the efficiency of P fertiliser.

Take home messages:
- These data demonstrate a significant yield response to the application of 20kg P/ha when compared to the control. There were no yield differences to the various treatments.
- The trial was moisture stressed in late spring but moderate grain protein levels indicate that the trial was not stressed for nitrogen.
- Visually it was difficult to pick any differences between treatments, however the poor growth of the control was very evident throughout the growing season and the Airseeder treatment appeared to lack early vigour, but at the end of the season this was not apparent.
- The application of zinc as either foliar or as fertiliser at sowing (Granulock Supreme Z treatments) did not result in additional yield.
- The liquid treatments did not prove to have any significant benefit over the solids fertilizer products; contradicting results from SFS Mininera trials in 2007 where liquid fertilisers proved to have distinct advantages as compared to solids.

Trial information:
The trial was sown as a completely randomised block design with 4 replicates. A standard P rate of 20 kgP/ha was used and an equal rate of N and S was applied as urea and ammonium sulphate at sowing. Additional treatments of 10 and 30 kgP/ha were also assessed in the trial.

Rainfall:

Avg. Annual:	589.7mm, Ararat Prison 1969-2008
Avg. G.S.R.:	449.4mm, Ararat Prison 1969-2008
2008 Total:	534.0mm, Mininera Research Site
2008 G.S.R.:	April – November = 330.5mm[1]

[1] 1/3 of Dec (70.5mm), Jan (79mm) & Feb (14.8mm) with monthly totals above 20mm + ½ March (22.5mm) rainfall when total above 20mm + ((April – November rainfall) – 90mm*) x 20kg/mm/ha. In total December-March adjusted rainfall to stored soil water = 61.0mm, plus April-November = 330.5mm, minus evaporation factor* =>301.5mm **Therefore, for Mininera, the Wheat Variety Trial water limited yield should be 6.03t/ha, or 301.5mm x 20kg/mm/ha.**

Treatment list:
10 different nitrogen strategies, consisting of granular urea and liquid UAN using four rates spread across two application dates. Measurements included yield and grain quality components, including protein, retention, test weight, screenings and resulting classification.

Cultivar: Ruby Wheat

Sowing rate: 80 kg/ha

Sowing date: 6th June 2008

Summary:
In 2008, the optimal strategy for yield from nitrogen applied after stem extension, was the single application treatment of 40kgN/ha (urea) at GS33, which yielded 7.18t/ha. Similarly, the optimal strategy for profitability was also the 40 kgN/ha (urea) at GS33 treatment, which returned a profit on investment of 66% or $104.22/ha. Therefore, it is reasonable to assume that the profit margin was not worth the additional risk and outlay, as growers should be aiming for at least a 150% return on investment, if not higher. As a result, the 0kgN/ha strategy appeared the most rational decision given the dry finish to the 2008 season.

Table 1: Treatments, P rate and cost $/ha

T.No.	Treatments	P rate	$/ha
1	Control (basal N only)	0	
2	MAP	20	85.92
3	MAP + Zincsol at DC12 - 15	20	89.67
4	MAP + granular $ZnSO_4$ blend (1% Zn)	20	98.47
5	Granulock SuPreme Z	20	94.74
6	Entec MAP	20	NCA[1]
7	Entec DAP	20	NCA
8	Entec Granulock SuPreme Z	20	NCA
9	Granulock SuPreme Z + Additive A	20	NCA
10	Granulock SuPreme Z	20	94.75
11	Granulock SuPreme Z + Humic acid	20	NCA
12	MAP	10	42.96
13	Granulock SuPreme Z	30	142.11
14	Easy NP (liquid)	20	274.40
15	Easy NP + Zn (liquid)	20	292.60
16	Easy NP + Zn + Additive B (liquid)	20	NCA
17	Easy NPK 27 (liquid)	20	313.60
18	Airseeder Super	20	126.76
19	Granulock 15	20	135.33
20	Evaluation MAP-sulphur product	20	NCA
21	DAP	20	94.08

(NCA- not commercially available)
[1] Costs calculated based on Incitec Pivot recommended retail price list dated 6/2/09.

Table 2: Top soil test

Depth	0-10
Ec	0.2
OC%	2.6
Col P	38
PBI	99
pH water	5.3
pH $CaCl_2$	4.6
S mg/kg	30
Zn mg/kg	0.32

Table 3: Deep soil nitrogen results

Depth cm	Nitrate N mg/kg	Ammonium N mg/kg	Total N kgN/ha
0-10	35	3.2	53.5
10-30	6.9	1.8	24.4
30-60	3.7	1.3	21
Total			99

Observations:

This trial site was chosen as it has a typical regional soil type and a representative cropping rotation. A combination of an acidic soil type and moderate soil phosphorus levels (Colwell P) (Table 2) indicate that this site should be phosphorus responsive as required for the purposes of this trial.

Deep soil N analysis (table 3) indicates moderate soil nitrogen levels and in an average year nitrogen should not have been a limiting factor. Adequate winter and reduced spring rains resulted in only average grain yields. The trial was moisture stressed in late spring but moderate grain protein levels indicate that the trial was not stressed for nitrogen. Visually it was difficult to pick any differences between treatments.

However the control (Treatment 1) was very evident throughout the growing season and the Airseeder treatment (Treatment 18) appeared to lack early vigour, but at the end of the season this was not apparent.

At harvest there were significant yield differences between treatments and the control (no P). (Table 4). All treatments at 20 kg P /ha significantly outyielded no P. There was no significant difference between treatment 10 (MAP @10 kg P/ha) and the control. But treatment 13 (Granulock Supreme Z @ 30 kg P/ha) was significantly higher yielding than many of the 20kgP /ha treatments.

It can also be observed that in the absence of applied P (treatment 1), grain protein % was the highest.

The application of zinc as either foliar or as fertiliser at sowing (Granulock Supreme Z treatments) did not result in additional yield. Soil test analysis for zinc (See table 2) plus a moderately acidic soil indicate that this was not a zinc responsive soil type.

The liquid treatments did not prove to have any significant benefit over the solid fertilizer products. This contradicts results from SFS Mininera trials in 2007 where liquid fertilisers proved to have distinct advantages as compared to solids.

The results from the fortified sulphur product (treatment 20) and the Humic acid added product (treatment11) warrant further investigation as alternative fertilizers.

Table 4: Grain yield results

T.No	Treatments	P rate	Yield t/ha	Protein %	Profit $/ha
1	Control (basal N only)	0	3.96	10.90	741
2	MAP	20	4.59	10.35	812
3	MAP + Zincsol at DC12 - 15	20	4.75	10.38	849
4	MAP + granular $ZnSO_4$ blend (1% Zn)	20	4.94	10.73	885
5	Granulock SuPreme Z	20	4.93	10.18	886
6	Entec MAP	20	4.60	10.68	808
7	Entec DAP	20	4.75	10.50	840
8	Entec Granulock SuPreme Z	20	4.53	9.95	783
9	Granulock SuPreme Z + Additive A	20	4.99	10.40	897
10	Granulock SuPreme Z	20	4.78	9.53	897
11	Granulock SuPreme Z + Humic acid	20	4.99	10.18	898
12	MAP	10	4.28	10.38	776
13	Granulock SuPreme Z	30	5.32	10.38	938
14	Easy NP	20	4.46	10.33	590
15	Easy NP + Zn	20	4.48	10.44	579
16	Easy NP + Zn + Additive B (liquid)	20	4.62	10.93	604
17	Easy NPK 27	20	4.85	10.18	649
18	Airseeder Super	20	5.07	10.73	892
19	Granulock 15	20	4.92	10.4	844
20	Evaluation MAP-sulphur product	20	5.11	10.38	938
21	DAP	20	4.63	10.60	813
	LSD (<0.05)		**0.44**	**0.69**	
	CV%		**2.5**	**4.7**	

Profit is calculated on cash price for APW wheat @$250/t. Cost of treatments taken from Incitec Pivot Ltd Recommended Retail Price List as of 6th February 2009. A maintenance cost for sowing, herbicide, harvesting etc was set at $250. Those treatments not commercially available (see table 1) have been costed on their basic ingredient (e.g.: Granulock Supreme Z) plus an estimated value of the additional treatment (e.g. Humic acid). The cost of liquid fertilisers are generally at a premium to solids (Table 1). Recent research has shown that to be cost effective liquids need to applied at significantly lower rates (eg 50%) and obtain similar grain yields. For the purposes of this trial, all liquids were applied at same P rates as solids.

Conclusions:

These data demonstrate a significant yield response to the application of 20 kgP/ha when compared to the control. There were no yield differences between the various treatments.

Most soils in the SFS region are naturally responsive to phosphorus applications but some responses may be small due to a long history of phosphorus application. Soil tests, such as Colwell P are helpful, but the general view would be that phosphorus at seeding – placed near the seed – is important to achieve yield potentials and is a relatively cheap form of insurance.

Although fertiliser prices have eased from the record levels of 2008, it remains important for grain growers to make good decisions about what phosphorus source to use. Although DAP is the most commonly used fertiliser for field crops, supplying an adequate balance of P and N, grain growers should not forget the role of S and the trace element Zn. Granulock Supreme Z either as a fertiliser by itself or in blends with urea and sulphate of ammonia will provide an adequate balance of a broad range of important nutrients.

This trial has again demonstrated the responsiveness of soils in this region to phosphate and the attractive returns that may be generated from well informed investment in starter fertilisers.