Sulfur and zinc responses in wheat

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Take home messages

- *Sulfurs and zinc fertiliser increased wheat yields by 120 to 300kg/ha above MAP + urea.*
- *Sulfur responses are most likely where S soil test levels (KCl) are below 7mg/kg sulfate and subsoil (10-30cm) sulfate levels are also low.*
- *Zinc responses are highest on soils above pH 7 or where total Zn levels in the soil are very low.*

Background

Sulfur (S) is essential for the growth and development of wheat crops. The most common cropping fertilisers - MAP, DAP and Urea - contain negligible levels of sulfur. The assumption is often made that the soil contains enough sulfur to supply the crop's needs. However, a two tonne wheat crop will remove approximately 3.6kg of S in the grain alone. Hay crops will remove substantially more. Therefore, after many years of cropping, it is not surprising that we are seeing responses to S fertiliser.

Zinc (Zn) deficiencies in wheat crops have been reported on numerous occasions in the past. Because Zinc is not very soluble in soils above pH 7, deficiencies are most common in alkaline soils. However, we have also measured Zn responses on lower pH soils where Zn has not been previously applied. Responses to Zn in these trials indicate that deficiencies continue to reduce wheat yields in the Victorian Mallee.

Aim

The aim of this work was to measure wheat response to sulfur and zinc fertiliser when applied in addition to nitrogen and phosphorus.

Method

Twenty replicated trials were sown across western Victoria, southern New South Wales and South Australia on sites with KCl sulfate soil test levels below 7mg/kg.

Trial sites managed by the Birchip Cropping Group were located at Curyo (2008), Woomelang (2009) and Nandaly (2009).

Fertiliser treatments are shown in Table 1. The MAP + sulfur and the MAP+S+Zn treatments were compound fertilisers; they contained every nutrient in every granule. Half of the S was sulfate-S and half was elemental S. The Zn source was ZnO, co-granulated with both MAP and S.

Application rates of each element are shown for trials in the Victorian Mallee. However, the trial at Curyo had a slightly different design which omitted the MAP only treatment. Urea was applied to increase the nitrogen rate to 20 kg/ha. Each treatment was replicated four times.

Wheat was sown at all locations. The variety Wyalkatchem was used at Curyo, Espada at Woomelang and CLF_STL at Nandaly. Crop row spacing was 30cm in these three trials.

Table 1. Fertiliser treatments tested. Application rates are shown for trials located in the Victorian Mallee.

Treatment	Nitrogen	Phosphorus	Sulfur	Zinc
	- - - - - - - - - - - - - - - - (kg/ha) - - - - - - - - - - - - - - - -			
1. Urea only	20	-	-	-
2. MAP	20	11.4	-	-
3. MAP+Zn	20	11.4	-	0.65
4. MAP+sulfur (S)	20	11.4	6.5	-
5. MAP+S+Zn	20	11.4	6.5	0.65

Results

Wheat grain yields were significantly increased by sulfur and zinc fertiliser. Co-application of S and Zn increased yield by 120kg/ha above the MAP only treatment at Woomelang (Table 2). At Curyo, sulfur increased wheat yield by 160kg/ha. At Nandaly, MAP+Zn increased wheat yield by 240kg/ha compared with the MAP treatment (Table 2). Co-application of S and Zn increased yield by 300kg/ha.

Averaged across the twenty trial sites, sulfur applied together with MAP significantly ($P \leq 0.05$) increased wheat yields by 87kg/ha, compared with using MAP alone (Figure 1).

Table 2. Wheat yield at three sites in north-western Victoria*

Treatment	Curyo		Woomelang		Nandaly	
Urea only	1.30	b	1.70	c	1.78	bc
MAP	-		1.77	bc	1.68	c
MAP+Zn	1.32	b	1.86	ab	1.92	ab
MAP+S	1.48	a	1.83	ab	1.79	bc
MAP+S+Zn	1.42	a	1.89	a	1.98	a

**In each column, values with the same letter were not significantly different ($P \leq 0.1$).*

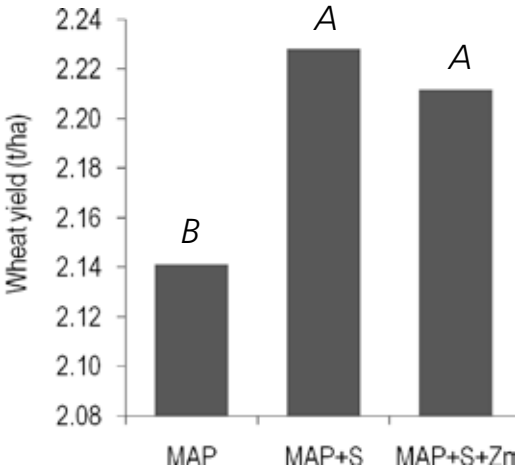

Figure 1. Average wheat yield with and without sulfur and zinc fertiliser across twenty trial sites with soil test (KCl sulfate) levels below 7 mg/kg. Bars with different letters are significantly different (P≤0.05).

Interpretation and Commercial Practice

We now have significant trial data showing that sulfur levels are low enough to affect wheat production at sites in the Victorian Mallee and at numerous other locations. In these trials, sulfur responses were most commonly encountered on sites with soil test levels (KCl sulfate) at or below 7mg/kg. However, having higher sulfate levels in the subsoil (10-30cm) will reduce the likelihood of sulfur responses.

Zinc deficiencies in wheat crops have been reported on numerous occasions in the past. They are most prevalent on higher pH soils, above pH 7, but occasionally occur on lower pH soils that have not had previous Zn application. These trials found that Zn deficiencies are still relatively common in wheat crops and that yield responses of between 120 and 300kg/ha are possible in the Mallee soils of western Victoria even though visual deficiency symptoms were absent.

Acknowledgments

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