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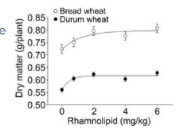

Take home messages
• With high grain prices, small increases in productivity can significantly improve farm profitability.
• A balanced crop nutrition program is extremely important to optimise crop yields.
• At Goolagong, NSW, wheat yields were significantly increased by the use of a balanced fertiliser regime including N, P, K, S, Mg and Zn.
• An analysis of gross margins showed that the application of secondary and trace elements would have significantly improved farm profitability.

Further trials will help determine the distribution of K, Mg, S and Zn responsive soils in southern Australia.

1. Managing secondary or trace nutrients in the current cropping environment
Balanced crop nutrition is extremely important to optimise crop yields under dry conditions. In 2007 field trials were planted at Goolagong in New South Wales to test wheat (Triticum aestivum cv. Ventura) responses to sulfur (S), zinc (Zn), magnesium (Mg) and potassium (K). Yields of both crops showed significant responses to secondary and micronutrients, compared with the application of MAP + urea alone. Moreover, gross margin calculations showed that a balanced fertiliser program would substantially increase farm profitability.

Field site and fertilisers used
The soil type selected for this study was a grey/black vertisol with a pH (CaCl2) of 6.0. Table 1 shows the nutrient analyses of fertilisers used in this study. Each plot was 12m long by 1.6m wide and received the equivalent of 22kg P/ha. Nitrogen rates were 18kg/ha, balanced between plots using granular urea. The fertilisers were applied in a randomised complete block design. Each treatment was replicated four times.

The field trials were sown in early May. Whole shoot samples were cut between the time of flag leaf emergence and early boot stage, Feekes Stage 9-10. Three one metre length samples were randomly selected and cut from the centre rows of each plot. The samples were dried, weighed and analysed for their nutrient contents. Grain harvest weights were recorded at maturity. Analysis of Variance (ANOVA) was used to determine whether there were significant grain yield and nutrient uptake responses to each fertiliser treatment.

Trial Results
Zinc application significantly ($P \leq 0.05$) increased wheat grain yield by 14% compared with MAP+urea alone (Table 1). Shoot nutrient analysis showed that Zn concentrations were within the deficient range (data not shown), below 15 mg/kg at Feekes stage 10 (Reuter and Robinson 1997). There was no significant S response at the site either applied alone or with Zn and/or a balanced K-Mg fertiliser. Shoot analysis showed that all plants had S concentrations within the adequate range (data not shown). The balanced K-Mg fertiliser significantly increased wheat grain yield by 15% over MAP alone (Table 1). However, average K and Mg concentrations in shoots were above the critical levels published by Bergmann (1992) and Melsted et al (1969).

Table 1. Response of wheat to MAP, S, K, Mg, and Zn at Goolagong in 2007

Fertiliser	Wheat grain yield (t/ha)	Yield increase over MAP (%)
MAP	2.18 a	
MAP + 10%S	2.25 a,b	ns
MAP+10%S+1%Zn*	2.43 b,c	11.68
MAP + 1%Zn + 3.6%K + 2.3% Mg*	2.45 b,c	12.60
MAP + 1%Zn	2.48 c	13.84
MAP + 3.6%K + 2.3% Mg*	2.49 c	14.67
MAP+10%S+1%Zn + 3.6%K + 2.3% Mg*	2.53 c	16.09

Within columns, values with the same letter were not significantly different ($P > 0.05$).
*Fertilisers tested in this trial were MicroEssentials SZTM and KMagTM

Gross Margins
Gross margins were calculated to determine the profitability of applying secondary and micronutrients at the trial site. Based on a wheat price of $345 /t ESR, the application of Zn and KMagTM would be profitable (compared with applying MAP alone) by keeping the application cost (based on 1.4 kg Zn/ha) below $117.70 /ha. The application of Zn would be profitable if the cost of 1.4 kg Zn/ha were below $101 /ha. At current fertiliser prices and by using the products tested in this trial, the application of balanced N, P, Mg, K and Zn would increase wheat gross margins by approximately $77.60 /ha.

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2. The chemistry of P placement; banding versus broadcast
Primary researchers: Kylie Dodd, Ganga Hettiarachchi and Mike McLaughlin

In P responsive soils, fertiliser banding is used to increase efficiency by improving early root contact with the fertiliser. Banding was also traditionally thought to increase efficiency by decreasing the area of contact between the soil and the fertiliser and thus reducing P fixation. The main mechanism that reduces P availability in calcareous soils is P precipitation in the form of calcium phosphates, such as apatite (Lombi et al. 2006). In acidic soils, the precipitation of P is predominantly due to the formation of compounds with aluminium and iron. High P concentrations may increase precipitation. Therefore a study was undertaken to determine whether concentrating P fertilisers into bands would increase P precipitation in calcareous soils. A laboratory and glasshouse study using isotope dilution techniques showed that banding P fertiliser granules did not significantly increase or decrease P fixation on the majority of soils tested. The results suggest that increased granular fertiliser efficiency with banding was primarily due to improvements in early root contact with fertiliser P rather than its effect on P fixation. When powdered MAP was mixed uniformly throughout the soils (this treatment would traditionally be thought of as a bad practice due to P fixation), the availability of P was much greater in the calcareous soils. This reinforces previous findings that suspensions and fluid fertilisers perform better on these soil types, in that they reduce P concentrations locally around the point of fertilisation and hence reduce precipitation of fertiliser P.

3. Emerging technologies for managing trace element deficiencies

The University of Adelaide and CSIRO Land and Water have developed two novel chelating agents which may help improve the efficiency of trace element fertilisers. Chelates, as used in fertilisers, are compounds that form soluble complexes with trace elements. They are used to prevent trace element precipitation and increase their solubility in soils. The most common chelates used in fertilisers are EDTA and DTPA. However, plants roots have difficulty absorbing these complexed forms of Zn. One of the new chelates, called rhamnolipid, forms lipid (membrane) soluble complexes with Zn, which improves Zn absorption across root membranes and increases Zn uptake by plants compared with both ZnSO4 and ZnEDTA. In calcareous soils, rhamnolipid has significantly improved Zn uptake by both bread and durum wheats (Figure 1, Figure 2 adapted from Stacey et al, in press). The second chelate, a positively charged polymer, also facilitates Zn uptake by roots and has significantly improved Zn uptake in wheat and canola under field conditions in South Australia (Figure 3) and New South Wales (data not shown). Further field trials are needed to confirm the efficiency of these products under field conditions in a wider variety of soil and climatic environments.

Figure 1. Response of bread and durum wheat to rhamnolipid application on a calcareous soil.

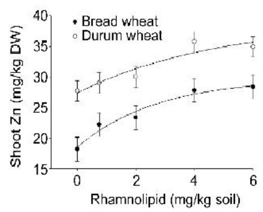

Figure 2. Effect of rhamnolipid on shoot Zn concentration in bread and durum wheat.

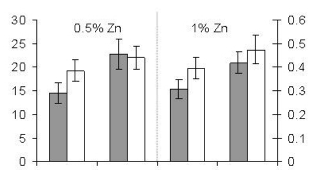

Figure 3. Effect of chelating polymer on canola dry matter production ( ) and Zn uptake (??) at Port Kenny in 2006.

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References

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