Manganese applications did not improve cereal yields in 2015 and 2016

Sjaan Davey[1], Nigel Wilhelm[1], Terry Blacker[2], Amanda Cook[3] and Ian Richter[3]
[1]SARDI, Waite; [2]SARDI, Port Lincoln; [3]SARDI, Minnipa Agricultural Centre

Key messages

- **There was no increase in wheat (2015) or barley (2016) performance with application of manganese on highly calcareous sands, even though these environments have regularly produced severe Mn deficiency in the past.**
- **Current industry guidelines still appear to be relevant for diagnosing trace element deficiencies in cereal crops and how they are best managed.**

Why do the trial?

There has been concern raised across the grains industry that:

1. strategies for managing trace element deficiencies are less well known than those for managing nitrogen and phosphorous deficiencies, and
2. trace element supplies in soils may not be adequate for current, more productive and more intensive cropping systems.

The reality is that trace element management packages for manganese (Mn), zinc (Zn) and copper (Cu) were developed 20-40 years ago in substantially different cropping systems. Speculation that these packages need to be reviewed and adapted to current farming systems, economic climate and the new cropping areas has driven two GRDC funded projects to investigate trace element deficiencies in the Australian cropping zones – one for Western Australia and one for the rest of the cropping zone. These two projects are assessing the current extent and severity of trace element deficiencies in typical cropping situations and also reviewing management guidelines for their effectiveness.

Trials investigating Zn, Mn, Cu and boron deficiencies have been conducted across the cropping zone of Australia over the last three years, including many on Eyre Peninsula. This article summarises the outcomes of several Mn trials conducted on upper Eyre Peninsula over the last two years.

How was it done?

Trial sites at Streaky Bay and Tooligie on highly calcareous sands with a known history of Mn deficiency were selected in 2015 and 2016. These sands have traditionally produced severe Mn deficiency in crops and pastures in most years. These small plot replicated trials were to evaluate Mn fertiliser rates and application strategies in a current variety of wheat or barley and had from 6 to 22 different Mn fertiliser strategies applied.

Each site was sampled for its soil Mn status prior to seeding. In season sampling included establishment counts, plant dry weights, and two timings of leaf samplings (youngest emerged blades, YEBs) for nutrient analysis. Grain yield data was assessed at maturity.

Data were analysed using Analysis of Variance in GENSTAT.

What happened?

None of the trials conducted in 2015 or 2016 recorded a response in grain yield to the addition of Mn in any form or timing (which also occurred for several trials conducted in the Coffin Bay area on the same soil type, another traditional area for severe Mn deficiency). Seeding applications of Mn did not affect establishment in any trials.

In 2015 YEBs of wheat at late tillering had an average of 27 mg Mn/kg at Streaky Bay, which is above deficiency levels in the existing guidelines and in a later sampling were still 29 mg Mn/kg. Grain yield averaged 1.2 t/ha, regardless of treatment.

In 2016 for barley at Streaky Bay, YEBs had an average of 19 mg Mn/kg and 13 mg Mn/kg, respectively for similar growth stages to the wheat trial. These levels are also above current thresholds for deficiency (10-15 mg Mn/kg at late tillering). None of the manganese treatments had an effect on yield, the site mean was 2.7 t/ha.

The barley trial at Tooligie in 2016 had slightly lower YEB values taken at similar stages to the Streaky Bay trials, 14.5 and 11.8 mg/kg respectively. These levels are considered marginal for barley so the outcome that all treatments yielded about 2.7 t/ha (i.e. no response) is not inconsistent with the plant testing guidelines.

What does this mean?

The outcomes from these Mn trials do not contradict the current guidelines where YEB values of greater than 15 mg Mn/kg at tillering (the first tissue sampling) indicate adequate manganese status and thus are unlikely to respond to additional Mn fertiliser.

For other trials in this project targeting Zn or Cu, similar findings have been made; existing guidelines for interpreting soil and plant tests appear to be still relevant to current cropping systems.

In the absence of crop responses to fertiliser strategies it is not possible to evaluate the effectiveness of management options so this component of the project could not be completed with these Mn trials.

This project has highlighted the difficulty in finding trace element deficient sites in current cropping systems and that tissue testing continues to be the best form of monitoring for trace element deficiencies. The most extreme example has been our experiences on the highly calcareous sands along the west coast of Eyre Peninsula. This environment was the “go to” region for field-based Mn deficiency research conducted in the 1980s and 1990s and many trials over those decades recorded frequent and extreme deficiencies in crops.

We have not found any Mn responses in our attempts over the last 3 years which raises questions whether systems have changed sufficiently that Mn deficiency is no longer as severe or prevalent as it once was. Better weed control, improved disease management, more adapted varieties, and in particular earlier seeding, all encourage better early growth and root development. With improved root systems, crops would scavenge more effectively for Mn in the soil and potentially avoid Mn deficiency. Or perhaps we were just unlucky!

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