Lime-induced trace element deficiency

Manganese trial - 2026 update

Summary

Liming acidic soils is a key tool to improve pasture production across Kangaroo Island. However, on our coarse sandy ironstone soils, liming can unintentionally induce trace element deficiencies—particularly manganese (Mn).

Applying lime causes the pH to rise and thus the availability of manganese to drop. This is an issue, given that mapping suggests up to 70,000 ha on KI may be naturally low in manganese, making this a widespread and potentially long-term productivity constraint.

While applying Mn appears to address the issue, key questions remain:

- What is the most effective rate?
- Should Mn be applied as foliar or granular?
- How long do responses last?

This project, funded through MLA's Producer Demonstration Site (PDS) program, aims to answer these questions under real farm conditions.

What was / will be done

In 2025, three sites were established across Kangaroo Island:

- **Key site:** Veitch (Moores Rd, Haines)
- **Demo site:** Bolto (Three Chain Rd, MacGillivray)
- **Advanced demo site:** Veitch–Ecketts: treated in 2023. (South Coast Rd, MacGillivray)

At the Key Site on Moore's Rd, a demonstration trial was established with the following treatment rates to compare the response rate on limed vs unlimed ground.

- **Granular:** 25kg, 50kg and 75kg Manganese Sulphate
- **Bare Earth Foliar:** 25kg, 50kg and 75kg Manganese Sulphate
- **In-season Foliar:** 1.6kg, 3.2kg and 4.8kg Manganse Sulphate – applied in August

The rates chosen at the Bolto demo site were 50kg/ha manganese sulphate for the bare earth spray and granular spread. The 'In-Season' foliar rate was 3.2kg/ha MnSO4.

During the growing season, various tests were carried out:

- dry matter cuts x 3 (FOO)
- pasture feed test
- leaf tissue test
- soil pH was monitored.

The results of the pH monitoring can be seen below in **Table 1**.

	Veitch site: $pH_{(CaCl2)}$	Bolto site: $pH_{(CaCl2)}$
0-2.5 Limed	6.4	6.1
2.5-5 Limed	5.5	6
5-7.5 Limed	5.3	5.1
7.5-10 Limed	4.8	5
10-15 Limed	5	4.8
15-30 Limed	5.1	5

Table 1: pH results through the profile.

Results

Tissue testing in September showed that manganese was the clearest nutrient issue across all sites, with the limed untreated strips recording lower Mn levels than comparable unlimed areas. Manganese sulphate applications increased clover tissue Mn concentrations, with foliar treatments giving the quickest and strongest lift, while granular and bare-earth treatments also improved Mn levels and may be more useful for longer-term correction.

While manganese was the clearest deficiency identified, zinc (Zn) levels were also frequently borderline low across several treatments. This suggests Zn may become a secondary limitation, particularly in limed soils or once Mn deficiency is corrected.

Early-stage trial sites (Veitch & Bolto)

Over the course of the year, the Veitch site grew ~3,979 kg DM/ha whilst the later season Bolto site grew ~6,078 kg DM/ha. However, there were no clear visual or production differences between treated and untreated areas at this stage. The key takeaway is that short-term responses to Mn are not always obvious.

Developing story – Veitch–Ecketts site

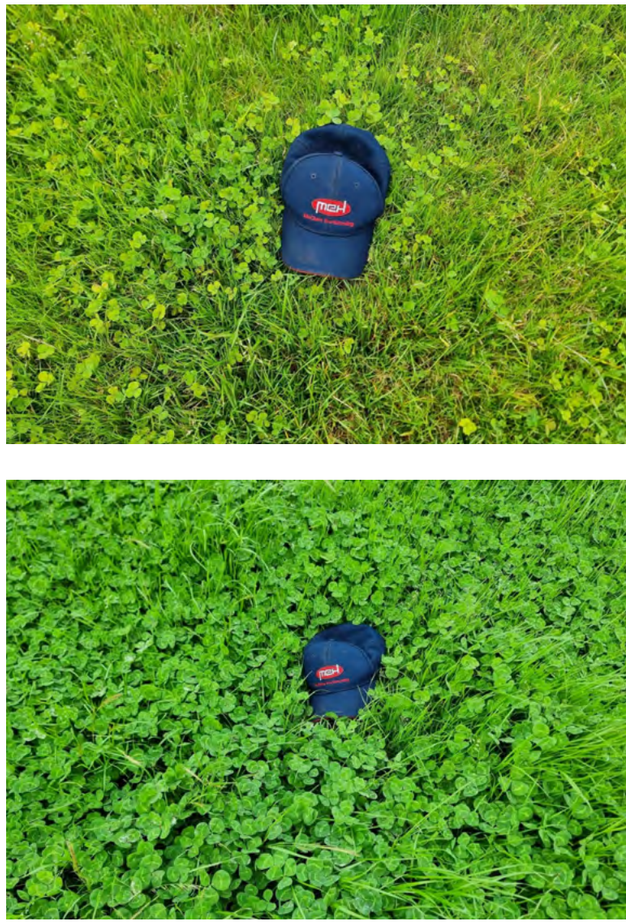
Our most important finding

This kikuyu paddock on the South Coast Road was treated with a bare earth spray of 32 kg/ha $MnSO_4$ (10kg Mn) in March 2023 with a strip left untreated. In August 2025, visual differences were noticed. The untreated strip (nil) was observed to be a more yellow colour with a higher silvergrass content and poor clover and kikuyu growth compared with the rest of the paddock.

Results from tissue testing of the clover between the treated and untreated areas (shown in **Table 2**) revealed a doubling of Mn in the treated clover.

	Treated	Untreated
Manganese	41.62	18.49

Table 2: Tissue test results, mg/kg. A reading bellow 20mg/kg is deemed deficient.



Above: Manganese rich pasture (left) and manganese deficient pasture after liming. (Photos: Keith Bolto.)

What does this mean?

Since manganese is required in nitrogen fixation, manganese deficiency leads to reduced nitrogen to the plant. Reduced N, means weaker clover and weaker clover creates opportunity for weeds such as silvergrass to creep in. In other words, if N fixation is optimised, it leads to strong clover that outcompetes weeds such as silvergass. Given that this manganese was applied evenly across the paddock as a bare earth spray in March 2023, it suggests that the manganese response may take 2+ years to express at the paddock scale.

Using granular manganese may take longer for the plants and livestock to cycle it across the paddock, but it does mean easier application as the granules can be mixed with your annual fertiliser. In the interim a foliar spray may still be required in the initial few year/s pending tissue test.

Next steps:

All three sites will continue to be monitored for dry matter production, feed tests and tissue tests in 2026, alongside pH tracking through the profile.

Schematically, the system looks like this:

Lime applied → **pH rises** → **Mn availability drops** → **Clover becomes Mn deficient** → **Nitrogen fixation fails** → **Clover weakens** → **Silvergrass fills gaps**

Take home messages

- Liming remains essential to support soil health and pasture productivity, however when there are low natural reserves of Mn, **liming exacerbates Mn deficiency.**
- **Manganese plays a critical role in the nitrogen fixation process in clover.** When Mn is deficient, clover struggles to fix nitrogen, leading to weaker pastures and increased invasion of low-quality species such as silvergrass.
- **Responses to high rates of applied Mn may take a couple of seasons** – don't expect instant results.
- **If you've limed and your clover isn't firing:** don't blame the lime – check manganese levels via tissue test.

MEAT & LIVESTOCK AUSTRALIA

Producer Demonstration Site

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Simon and Marissa Veitch, Keith and Erica Bolto, Lachlan Florance, Steven Childs

Further information

Lyn Dohle, PIRSA Kingscote

0419 846 204
lyn.dohle@sa.gov.au

Jenny Stanton

0484 602 946
jennybehenna@hotmail.com

