

Lime Trials

Background

Soil acidity is the most significant land degradation issue on Kangaroo Island with an annual loss of production cost of more than \$1.5 million. Liming is the best way to treat acid soils but how do we do this most effectively and efficiently? A research trial has been running for three years on KI. There are two parts to the trial:

- Rate response trial – comparison of three rates of surface-applied lime sand with a control (no lime)
- Novel treatment (rate, incorporation) trial – comparison the effectiveness of high rates of lime and incorporation (using offset discs) to manage sub soil acidity.

Agriculture Kangaroo Island (AgKI) are delivering this trial as part of a multi-state project. There are 10 sites in total – one on Kangaroo Island, two in the South East of South Australia, two in Tasmania, two in Gippsland and three in Southwest Victoria. Whilst 2021 was the last year of the trial, GRDC has agreed to provide ongoing funding ensuring that we can continue to monitor and learn from the trial site.

What was done

Rate Response Trial

The trial site was established in early 2019, on Simon & Marisa Veitch's property off Jenkins Rd, MacGillivray. The starting topsoil (0-10cm) $\text{pH}_{\text{CaCl}_2}$ was 4.8; for the rate response trial, the following treatments were randomly applied in four replicates, using local lime sand:

- Control: no lime was applied
- Treatment 1: low rate of 0.5t/ha to target a rise in $\text{pH}_{\text{CaCl}_2}$ from 4.8 to 5.0 (0.6t/ha lime sand)
- Treatment 2: moderate rate of 1.8t/ha to target a rise in $\text{pH}_{\text{CaCl}_2}$ from 4.8 to 5.5 (2.4t/ha lime sand)
- Treatment 3: high rate of 3.2t/ha to target a rise in $\text{pH}_{\text{CaCl}_2}$ from 4.8 to 6.0 (4.1t/ha lime sand)

Novel Treatment Trial

For the novel treatment trial, four treatments and a control were applied in four replicates at each site, to improve the starting $\text{pH}_{\text{CaCl}_2}$ from 4.4 (topsoil 0-10cm), 4.6 (subsoil 10-20cm) and 4.9 (20-30cm) to 5.8 (0-10cm), 5.3 (10-20cm) and 5.0 (20-30cm). A set of offset discs were used to incorporate the lime in

applicable plots. The treatments are as follows:

- Control: no lime + no cultivation
- Treatment 21: farmer rate surface lime – applied at 1.85t/ha (2.5t/ha lime sand)
- Treatment 22: high rate surface lime – applied at 4.0t/ha (5.4t/ha lime sand)
- Treatment 23: high rate surface lime + incorporation – applied at 4.0t/ha (5.4t/ha lime sand)
- Treatment 24: incorporation only (no lime)

The site was sown with lupins in 2019, wheat in 2020 and a hay mix in 2021. The site was soil sampled in Dec 2021. As the site was sown to hay, no yield data was recorded.

Results

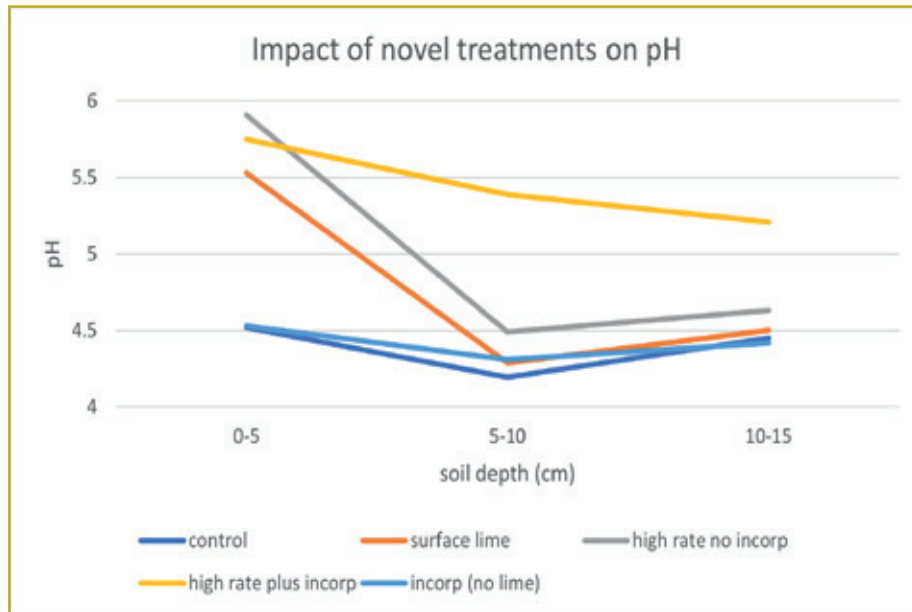
Soil pH changes down the profile were measured in the novel treatments trial. pH was measured in increments of 0-5, 5-10 and 10-15 cm down the profile and compared to the control (no lime applied) in December 2021 (refer to Graph 1).

As expected, the high rate of lime (5.4t/ha lime sand) treatments had the greatest impact on soil pH, increasing the soil pH by almost 1.5 units in the topsoil. The incorporated lime increased pH by more than 1 unit in the 5-10cm & 10-15 cm layer. Whilst incorporation of the lime provided the highest increase to depth, surface application of the high rate still had some impact at depth.

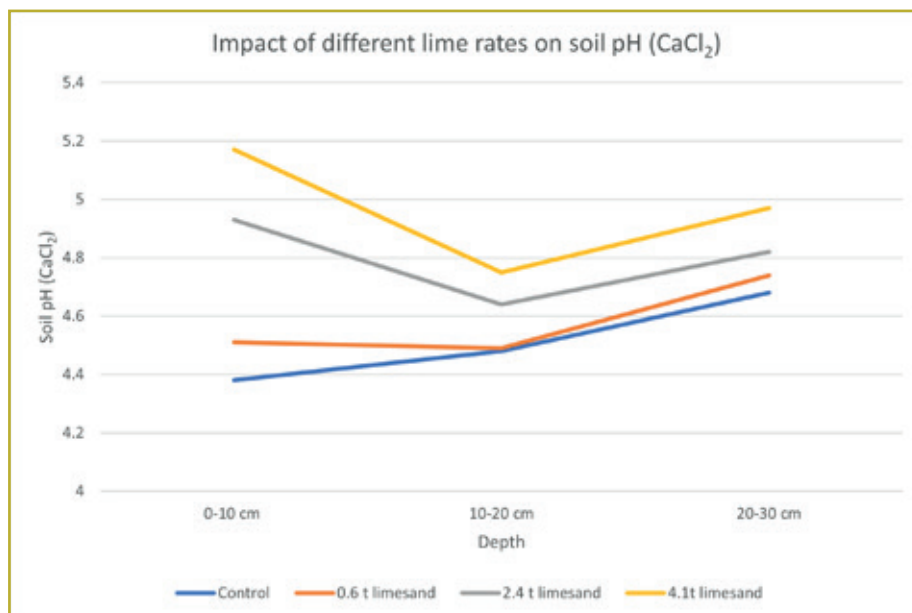
Surface application at 2.5t/ha improved the topsoil pH by almost 1 unit in the top 5 cm but had less of an impact at depth.

These initial results indicate that to change soil pH at depth ideally requires some form of incorporation and/or higher application rates. Graph 2 is further evidence that it will take higher rates of lime application to drive pH change at depth. This is of particular importance to KI, as we have significant issues with sub soil acidity. Once pH falls below $\text{pH}_{\text{CaCl}_2}$ 4.8, aluminium toxicity can occur. High Al levels burn the root hairs, inhibiting the plant's uptake of nutrients and water.

As expected, the highest rate of lime (4.1t/ha) had the greatest impact on improving soil pH right through the profile, increasing the soil pH by almost 0.8 of a unit in the top 10 cm. 2.4t/ha increased pH by just over 0.5 unit, but the low rate of 0.6t/ha had minimal impact on pH. Note there was no incorporation of lime with this trial.



Left: Graph 1: Novel trial – soil pH changes to 15cm.



Left: Graph 2: Rate response trial – pH changes at depth.

Take home message

- The most effective way to increase pH at depth is through incorporation plus higher application rates.

Funding/Sponsors

- AgKI in conjunction with Southern Farming Systems, through funding from the Australian Government’s National Landcare Program.
- Simon and Marisa Veitch
- Project partners - Precision Agriculture, Federation University – the Centre for eResearch and Digital Innovation (CeRDI), Australian Fertiliser Services

Association, Victorian Lime Producers Association, Victorian Department of Agriculture and Glenelg Hopkins Catchment Management Authority.

Further Information

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