Lime Trials

Background

Soil acidification affects 76% of topsoils and 73% of subsurface soils on Kangaroo Island, with an annual loss of production cost of $1.5 million (2018). Liming has the potential to save you yield penalties, but how do we do this most effectively and efficiently? A three-year research trial aims to investigate the impact of precision lime application rate, placement and product on cropping land and will evaluate cost effective ways to ameliorate subsoil acidity. 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 of two rates of lime sand, comparing surface-applications of the different rates, plus seeing what the effects of incorporation of a high rate of lime are, using offset discs (10-15cm) 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. The project will run over three seasons, finishing in June 2022.

Other partners involved in this project are 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.

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) pH_{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 pH_{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 pH_{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 pH_{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 pH_{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 and wheat on 10th May 2020. The site was harvested on 19 December 2020.

Results

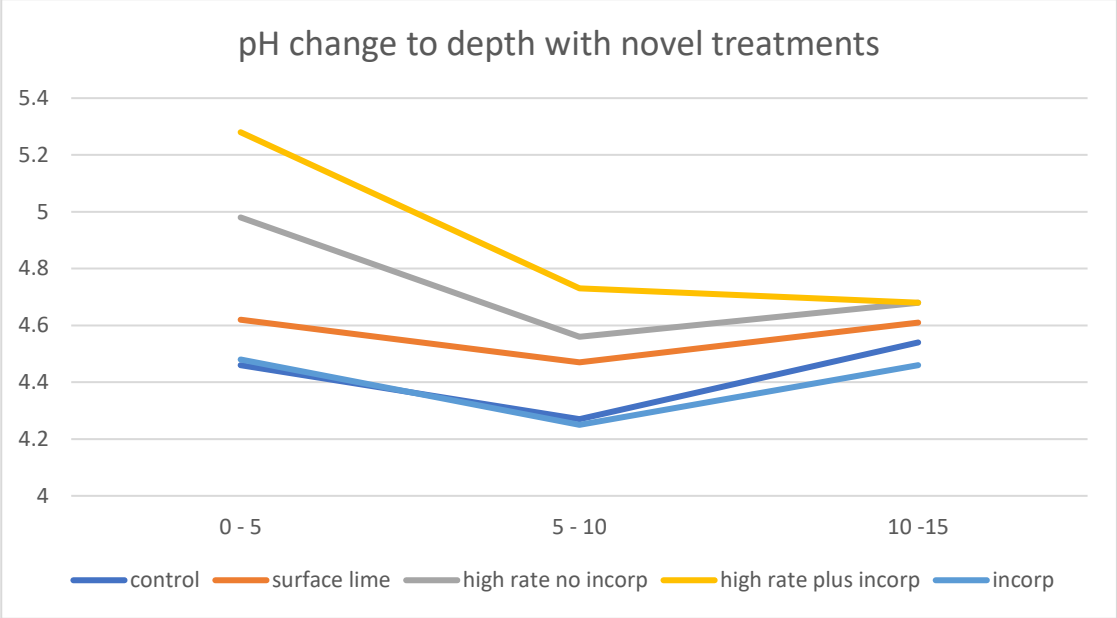
Novel trial - Soil pH changes to depth.

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 March 2020, 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 unit in the topsoil and 0.5 of a unit in the 5-10cm layers. Whilst incorporation of the lime provided the highest increase, surface application of the high rate still had an impact at depth.

Surface application at 2.5t/ha improved the topsoil pH by about 0.2 of a unit and had some 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 1. pH^{CaCl} changes to depth with novel treatments

Yield results novel and rate trials

The highest yielding treatments occurred on the high lime plots, refer to Graph 2.

- 5.4 t/ha lime and incorporated to depth yielding 4.21t/h -compared to control 3.33t/ha and
- 4.1t/ha lime sand surface application yielding 4.19 t/ha compared to the control of 3.64 t/ha.

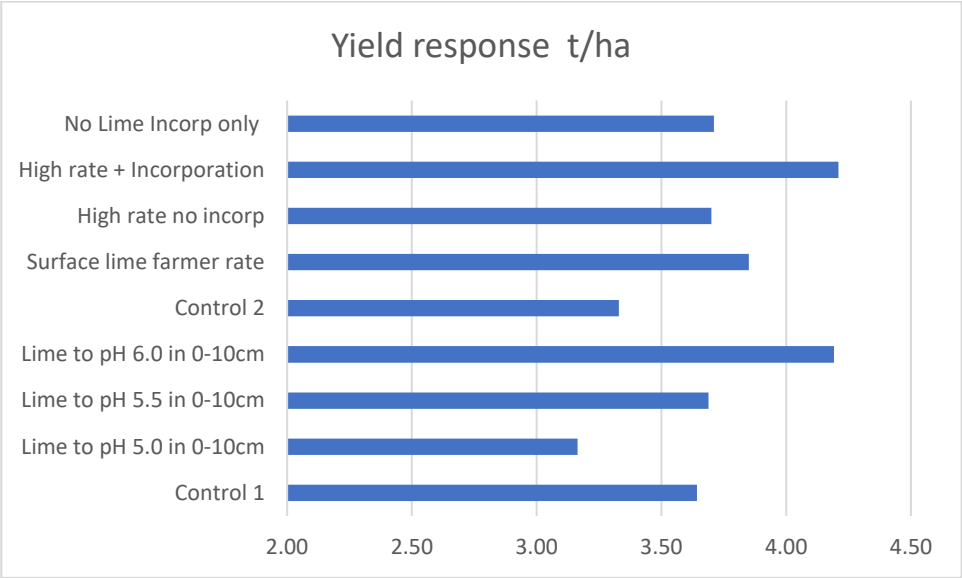
There was limited variation in moisture or protein levels between the treatments and controls.

Table 1. Lime rate response and novel treatment summary statistics

Treatment	**Yield (t/ha)**	**Moisture (%)**	**Protein (%)**
Rate Response Trial			
Control	3.64 [a b *]	12.43	11.88
Lime to pH 6.0 in 0-10cm (4.1t/ha lime sand)	4.19 [c]	12.45	11.72

Lime to pH 5.5 in 0-10cm (2.4t/ha lime sand)	3.69 [b c]	12.40	11.67
Lime to pH 5.0 in 0-10cm (0.6t/ha lime sand)	3.16 [a]	12.45	11.65
Novel Treatments Trial			
Control	3.33 [a]	12.55	10.8
High rate + Incorporation (5.4t/ha lime sand)	4.21 [a b]	12.40	11.0
Incorporation only	3.71 [b c]	12.53	11.2
high rate no incorp (5.4t/ha lime sand)	3.7 [c]	12.43	11.4
Surface lime farmer rate (2.5t/ha lime sand)	3.85 [a b]	12.45	11.0

- Note: a, b or c indicate if there is a statistical difference between treatments. Treatments with superscript are NOT statistically different



Graph 2. Yield response all treatments

Take Home Messages

- These initial results indicate that to change soil pH at depth ideally requires some form of incorporation and/or higher application rates
- In the second year of monitoring, there was a significant increase in yield with the high rates of lime application (either incorporated or surface application)

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