FutureSOILS

Soil acidity and declining soil organic carbon (SOC) affect more than half of the agricultural soils of southern and central NSW, and threaten the viability and resilience of farming systems.

Liming practices of recent decades have often been ineffective in managing soil acidity. Low lime rates and poor incorporation has increased pH in the 0-5 cm shallow surface soil layer, but the soil below continued to acidify, affecting plant performance.

Field research conducted by NSW DPI has indicated that maintaining the 0-10 cm soil above pH_{Ca}>5.5 enables gradual removal of acidity in layers below 10 cm.

- What are the most effective methods to increase soil pH to the desired targets or prevent soil acidification?
- How important is incorporation for effective acid soil management?

The FutureSOILS project aims to answer those questions for growers and build new online tools to help growers make decisions about lime application.

The project is funded by the Australian Government's National Landcare Program; the work is a collaboration between NSW DPI, the Australian National University, FarmLink, Holbrook Landcare Network, Central West Farming Systems and Incitec Pivot Ltd. Three farmers from Burrumbuttock, Grenfell and Trundle are also involved.

The field sites test new liming strategies, that target soil pH_{Ca} of near 6, with a re-lime trigger when soil pH_{Ca} the 0-10cm drops to 5.5, against traditional liming practices and untreated (control) treatments.

Burrumbuttock field trial

The trial was established in 2020. The following treatments were applied to achieve specified soil pH targets:

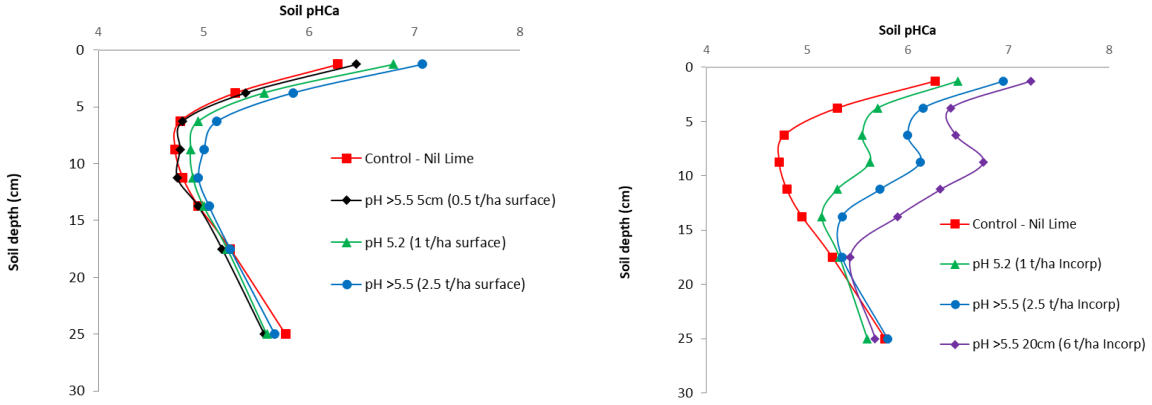
Table 1. Burrumbuttock xyz

Treatment pH target	Lime rate (t/ha)	Application detail
control	0	untreated soil
pH 5.2 surface	1	lime applied to the surface at rate of 1t/ha which theoretically would raise the pH of the 0-10 cm to pH 5.2. To be surface re-limed once pH drops to below pH 5.0 in the 0-10 cm layer; representing historic liming practice.
pH 5.2 incorporated	1	as above but incorporated with a scarifier to a depth of 10 cm.
pH >5.5 surface	2.5	lime applied to the surface at a rate of 2.5 t/ha which should raise the soil pH of the 0-10 cm to pH 5.9. To be surface re-limed once pH 0-10 cm drops to pH 5.5.
pH >5.5 incorporated	2.5	as above but incorporated with a scarifier to a depth of 10 cm

pH >5.5 in surface 0-5 cm	0.5	lime applied to the surface at a rate of 0.5 t/ha which should raise only the soil pH of the 0-5 cm to pH 5.9. To be surface re-limed once pH 0-5 cm drops to pH 5.5.
pH >5.5 in 0-20 cm incorporated	6	lime applied to the surface at a rate of 6 t/ha and incorporated with scarifier to 10 cm which should raise the soil pH of the 0-20 cm to pH 5.9. To be surface re-limed once pH 0-10 cm drops to pH 5.5.

Results

The soil pH profile from 2022 sampling is shown below. Surface applied lime has had little effect on the subsurface layers (left graph). Incorporation of lime has had an effect down to approximately 15cm (right graph).



Note: values are adjusted relative to the control.

Stunted plants with poor root development, lower emergence counts and lower biomass were found in the higher lime rate treatments. Plant tissue analysis identified Molybdenum (Mo) at toxic levels. CSU Agricultural Science Honours student work investigating Mo in sub-clover reinforces this. The trial site paddock has a history of Mo application with the last application in 2018 at 120g/ha.

Summary

- Surface applied lime has little effect on subsurface layers in the short-term (2 years post-lime application).
- Incorporated lime has increased pH in the subsurface down to approximately 15cm.
- Molybdenum (Mo) toxicity has occurred in the higher lime rate treatments resulting in stunted canola plants. Historical Mo application has occurred in the trial site paddock.
- Avoid high lime rates in paddocks with a history of Mo application.
- If pH is above 5 then Mo application is not required.