BEST PRACTICE LIMING DEMONSTRATION TO ADDRESS SUB-SOIL ACIDITY IN NORTH EAST VICTORIA

KEY MESSAGES

- **Lime incorporation is essential in broadacre cropping soils to optimise benefits**
- **Farmers in the Riverine Plains should assume that their farm has some degree of subsurface acidification, unless soil test results prove otherwise**
- **To-date, results from the Best-practice liming trial show that when lime is applied without incorporation, it only impacts pH levels at the surface and does not flow down through the soil profile**
- **Incorporating lime by sowing changed pH in the top 5cm, with the rate of change depending on the quantity of lime applied**
- **Shallow discs moved the lime to 15cm, while the Horsch Tiger moved lime to 20cm as targeted**
- **Farmers should only incorporate lime to the depth that is suitable for that soil, as other soil constraints (eg sodicity, slaking), seedbed preparation, emergence and trafficability can come into play.**

OVERVIEW

This project involves the establishment of a replicated field trial to demonstrate best practice liming strategies, as well as a field demonstration of the impacts of lime quality, each year for three years. The trials are designed to demonstrate different incorporation methods, evaluate the impact of different lime types and sources and extend findings, including comparisons of the economic and agronomic returns using the *Acid Soils SA* calculator tools.

Trials were established in the Rutherglen district of Victoria and monitored for three years during 2022, 2023 and 2024. Treatments were initially undertaken in 2022, however these trials had to be abandoned prior to harvest due to waterlogging and slug damage as confounding variables.

Extension efforts continue to focus on raising farmer awareness about the speed of acidification and stratification of soils in this region, including providing resources and tools available to assist management decisions.

Soil analysis over time has been used to illustrate the impact of lime incorporation methods and the impact of lime source and quality on efficacy of addressing stratified subsoil acidity. This is in addition to assessing the economic benefits of each treatment and potential losses of production and decline in pH. A null control — where no lime is applied — was used to highlight the cost of complacency when addressing pH issues in both the short and long term.

The data generated through this project is helping farmers evaluate the most practical and economical methods to manage soil pH and paddock variability.

AIM

The objective of the project is for growers and advisers in north east Victoria to have an improved understanding of the state of topsoil and subsoil acidity, the limitations to crop profitability it causes, and an improved knowledge of the agronomic and economic benefits of different lime sources, lime quality and incorporation methods.

WORK TO DATE

Treatments for the project were developed in consultation with a steering committee made up of growers and researchers. These treatments are shown in Table 1.

Table 1 Best practice liming trial treatments

TREATMENT #	DETAILS
1	Control – nil lime, nil incorporation
2	Nil lime, with incorporation
3	Lime to target pH 5.2, incorporated by sowing
4	High rate of lime (to pH 5.8 in 0-10cm value), incorporated by sowing
5	High rate of lime (to pH 5.8 in 0-10cm value), incorporation by shallow discs
6	High rate of lime (to pH 5.8), deep incorporation to 10-15cm, follow up with speed-tiller
7	High rate of lime (to pH 5.8), to deep incorporation to 10-15cm, follow up with speed-tiller (rate calculated for pH 5.8 at depth) Deluxe option

An intense soil sampling regime was completed in February 2022 across each replicate. This provided baseline information to characterise the whole site, as well as an understanding of current pH levels to ensure that the proposed incorporation methods were appropriate. Using this information, it was calculated that the rates of lime used in that year would be:

- Lime required to achieve a target pH of 5.2: 1.2 tonnes/ha
- Lime required to achieve a target pH of 5.8 (high rate): 5.0 tonnes/ha
- Lime required to achieve a target pH of 5.8 to depth (high rate to depth): 8.5 tonnes/ha

The application of lime to these levels was done using a range of surface and incorporation techniques, including a shallow incorporation by sowing, incorporation by discs to a depth of 15cm and a deeper incorporation by a Horsche Tiger to a depth of 20cm.

Fine lime was sourced from a manufacturer in Galong and coarser lime was sourced from a manufacturer in Mt Gambier.

Figure 1 shows the layout of the field-scale replicated trial, which includes a buffer sown to wheat, in 2023. At one end of the replicated trial, strip trials were established to assess the impacts of two types of lime quality, granular (Mt Gambier lime) and fine (Galong lime), applied at 3t/ha and incorporated with sowing. The lime from Galong was very fine, with bulk density of 1.4, while the Mt Gambier lime was much coarser, with a bulk density of 1.1.

TRIAL PLAN	
Demonstration 1: Mount Gambier lime 3t/ha, incorporate by sowing	
Demonstration 2: Nil lime, incorporate by sowing	
Demonstration 3: Galong lime 3t/ha, incorporate by sowing	
1 Lime 5 t/ha, incorporate with TIGER	28 Lime 5 t/ha, incorporate by sowing
2 Lime 5 t/ha, incorporate by shallow discs	27 No lime, with incorporation
3 Control, nil lime, nil incorporation	26 Lime 1.2 t/ha, incorporate by sowing
4 Lime 1.2 t/ha, incorporate by sowing	25 Lime 5 t/ha, incorporate by shallow discs
5 No lime, with incorporation	24 Lime 8.5 t/ha, incorporate with TIGER
6 Lime 8.5 t/ha, incorporate with TIGER	23 Lime 5 t/ha, incorporate with TIGER
7 Lime 5 t/ha, incorporate by sowing	22 Control, nil lime, nil incorporation
8 Control, nil lime, nil incorporation	21 Lime 8.5 t/ha, incorporate with TIGER
9 Lime 5 t/ha, incorporate by sowing	20 Lime 5 t/ha, incorporate by shallow discs
10 Lime 5 t/ha, incorporate by shallow discs	19 Lime 5 t/ha, incorporate by sowing
11 No lime, with incorporation	18 Lime 1.2 t/ha, incorporate by sowing
12 Lime 5 t/ha, incorporate with TIGER	17 No lime, with incorporation
13 Lime 8.5 t/ha, incorporate with TIGER	16 Control, nil lime, nil incorporation
14 Lime 1.2 t/ha, incorporate by sowing	15 Lime 5 t/ha, incorporate with TIGER

Figure 1 Liming demonstration trial layout **Plot size 40m x 13m, buffer 30m**

Lime was applied on 16 February 2022, with the incorporation completed on 17 February 2022. A Horsch Tiger was used for the deep incorporation, with calibration to ensure that the depth of the lime was kept above 20cm. The speed tiller was run over both incorporated treatments to ensure a smooth surface for ease of sowing. Once the treatments were completed, the host sowed and managed the trial site in line with the management practices used for the remainder of the paddock.

Soil sampling was conducted in January 2022, before the treatments were established, and resampled in January 2023 and 2024 to enable a direct comparison of liming treatments and their effect on soil properties over time. Soil samples were collected in increments of 0-5, 5-10, 10-15, 15-20 cm using a hand corer, while the 20-30, 30-40, 40-50 cm depth increments were collected using a hydraulic trailer-mounted corer.

The site was sown to Scepter wheat on 13 May 2023, with 80 kg/ha of MAP and 50 kg of urea. An additional 175kg/ha of urea was applied during the season.

GreenSeeker® NDVI measurements were taken on 20 July, 15 August and 4 September to assess any differences in growth of the plots (data not presented). Photos were also taken during the season as a record of plot growth.

The trial was harvested using a plot header on 19 December 2023, with yield ranging from 9.8 – 11.1 t/ha. The host farmer harvested the remaining crop on the trial site, along with the rest of the paddock.

OBSERVATIONS AND COMMENTS:

The results presented in this article are a subset of the data collected. A full article will be produced when the project is completed in 2025.

Results from the trial to date show that when lime is applied without incorporation, it only impacts pH levels at the surface and does not move down through the soil profile. Figures 2a and 2b show that acidification is occurring in the soil when no lime is added.

Figures 2c and 2d show that incorporating lime by sowing can result in lime influencing pH in the top 5cm, with the rate of change depending on the quantity of lime applied. Incorporation of lime using shallow discs (Figure 2e), or deeper incorporation with the Horsch Tiger (Figure 2f, g), enables the lime to move further down the profile, to the depth of incorporation. Shallow discs moved the impact of liming to 15cm, while the Horsch Tiger moved lime to 20cm.

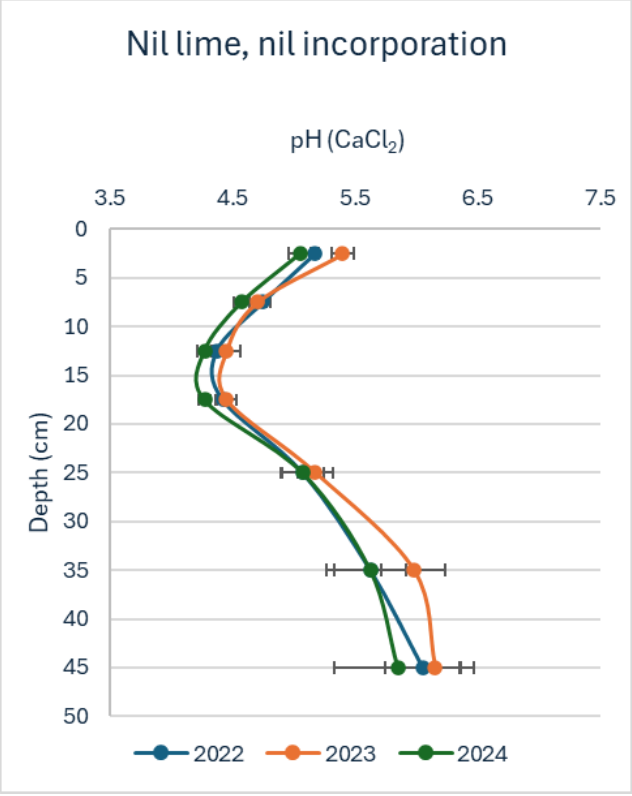

Figure 2a Soil pH results for Treatment 1: nil lime, nil incorporation, 2022 (pre-liming), 2023 and 2024

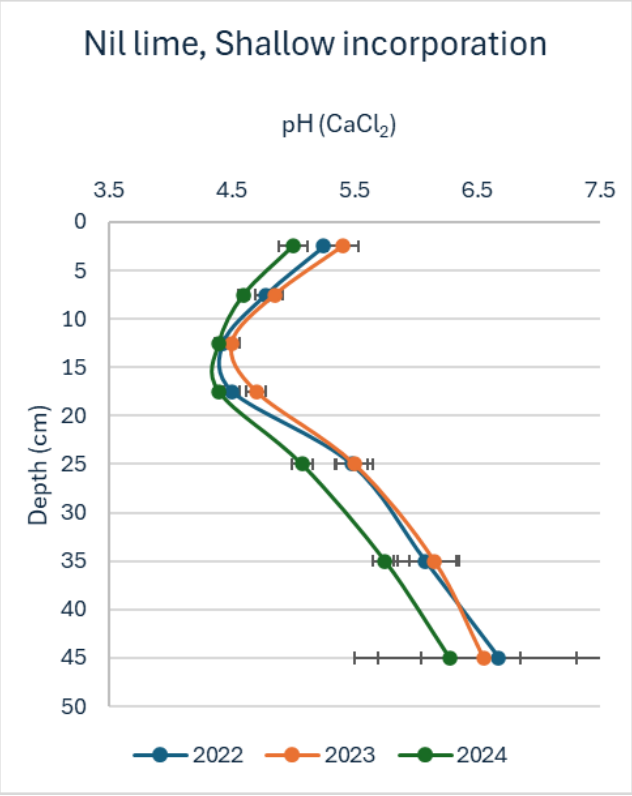

Figure 2b Soil pH results for Treatment 2: Nil lime with shallow incorporation, 2022 (pre-liming), 2023 and 2024

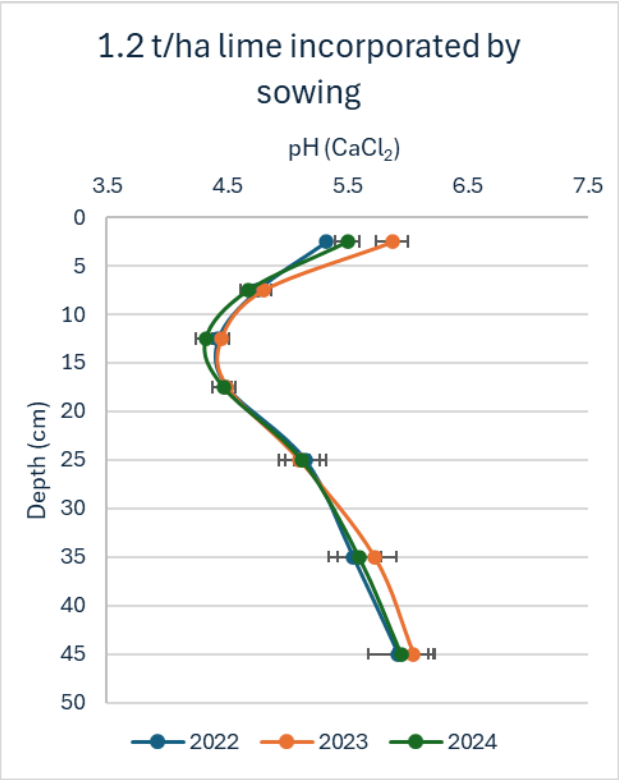

Figure 2c Soil pH results for Treatment 3: lime to target pH 5.2, incorporated by sowing, 2022 (pre-liming), 2023 and 2024

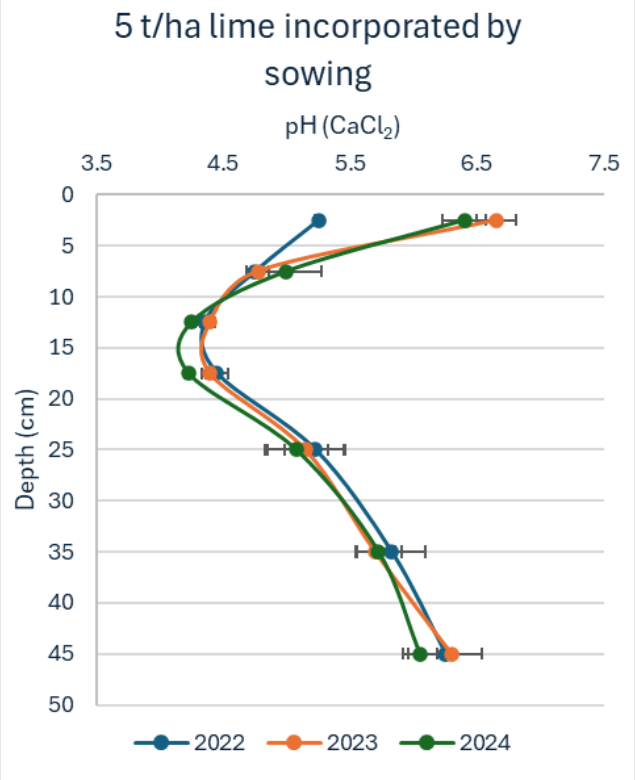

Figure 2d Soil pH results for Treatment 4: high rate of lime to target pH 5.8, incorporated by sowing, 2022 (pre-liming), 2023 and 2024

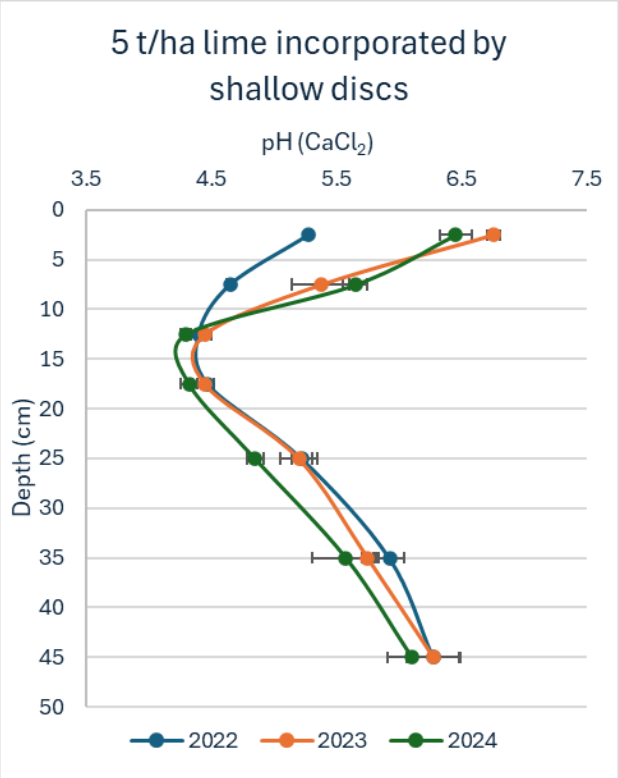

Figure 2e Soil pH results for Treatment 5: high rate of lime to target pH 5.8, incorporated by shallow discs, 2022 (pre-liming), 2023 and 2024

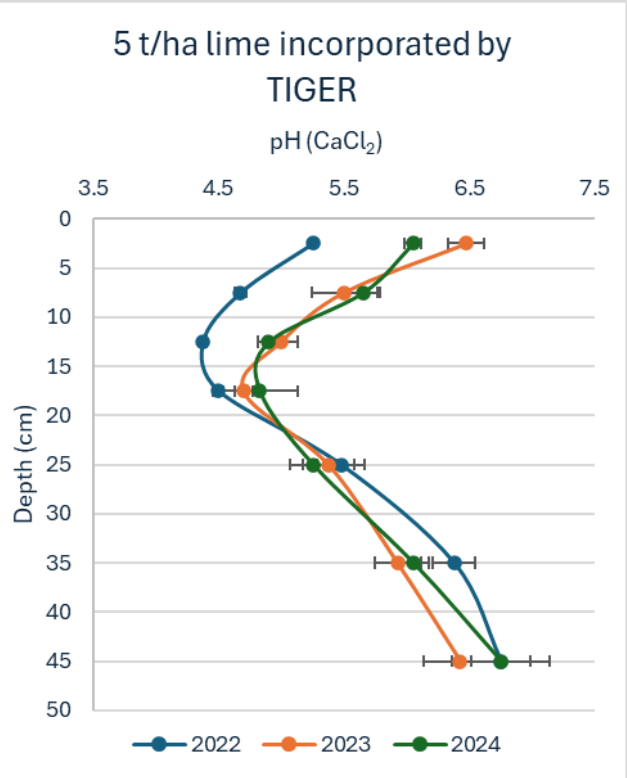

Figure 2f Soil pH results for Treatment 6: high rate of lime to target pH 5.8 with deep incorporation 2022 (pre-liming), 2023 and 2024.

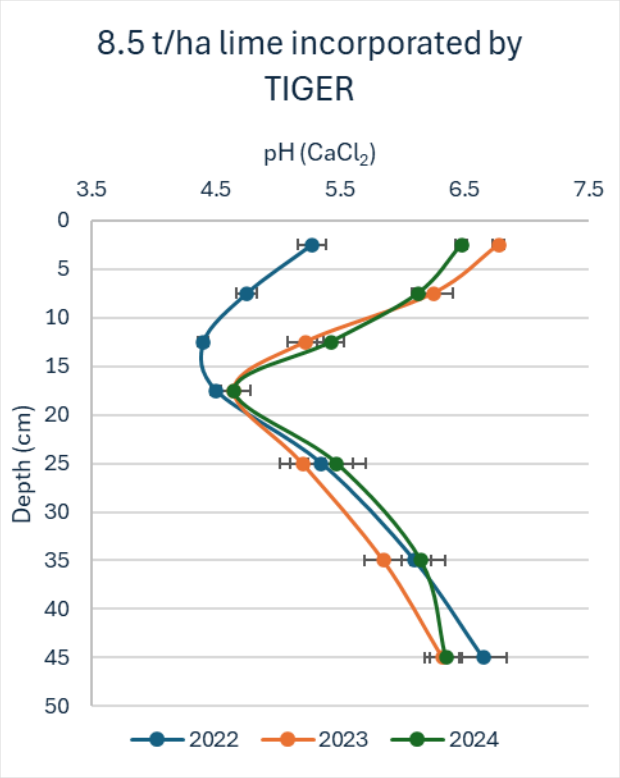

Figure 2g Soil pH results for Treatment 7: high rate of lime to target pH 5.8 with deep incorporation, 2022 (pre-liming), 2023 and 2024

While deep incorporation has shown positive results, it's important that farmers only incorporate lime to the depth that is suitable for that soil, as other soil constraints (eg sodicity, slaking), seedbed preparation, emergence and trafficability can come into play.

For example, if you can only cultivate to a depth of 10cm, load up that zone with adequate lime for full amelioration, so that it can move to depth over time.

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