Arresting falling pH in fight against subsoil acidity

Location: 'Fairview', Burrumbuttock, NSW

Enterprises: 1200 hectares mixed farming operation: self-replacing, fine-wool Merino flock with annual cropping area of 800-900 ha (wheat, barley and canola grain production).

Owner: Joe Corrigan (Rubenview Pty Ltd)

Key points

- Acceptable yields from canola and lucerne does not mean soil acidity is under control
- Arrest subsoil acidity before toxicity affects plant growth and productivity
- Regular soil testing monitors change in soil pH and prompts timely re-liming.
- Zonal soil sampling allows inputs to be efficiently allocated to soil and crop requirements.

Introduction:

For nearly 30 years farmers of the eastern Riverina-Murray region of NSW have prioritised paddocks for liming based on soil samples collected at 0-10 cm intervals, with pH_{Ca} (using the calcium chloride test) of around 4.8 and exchangeable aluminium (Al_{ex}) about 5%, with lime applied at rates just enough to increase pH_{Ca} to about 5.2.

These traditional acid soil management practices have not increased pH in the subsurface layers below 5 cm. Detailed soil sampling in 2016 to 2018 by NSW Department of Primary Industries (DPI) and Murray LLS indicated that subsoil acidity is increasing in some of the most productive agricultural land of the region, despite many paddocks having a history of over 20 years of lime application.

This information prompted Joe Corrigan to join the 'Tackling Acid Soils' soil monitoring program with Holbrook Landcare Network, linking with NSW DPI and supported by funds through the Federal Government's National Landcare Small Grants Program.

Background

After purchasing his home block, 'Fairview', in 1998 Joe Corrigan identified soil acidity as one of the issues he needed to address to optimise productivity on the red and grey loam soils that dominate his operation. Soil samples collected from 0-10 cm sampling depths indicated a soil pH_{Ca} of 4.3 to 4.6.

Such severely acidic pH levels required lime application before canola or lucerne into the crop and pasture programs. Budget limited lime tonnage and the decision was made to use relatively low rates of 1 t/ha to treat as much of the acidic area as quickly as possible to raise pH_{Ca} to 5.0. The lime was topdressed and then incorporated by sowing just prior to sowing canola, with paddocks re-limed every four to five years.

Over the last 10 years Joe has monitored changes in soil pH (as well as phosphorus and nitrogen) with Peter Baines of Precision Farming. Initial electromagnetic (EM) surveys of paddocks were used to identify management zones based on soil type. To simplify logistics paddocks were split into just two management zones. This was followed by more detail sampling of the zones to target lime inputs according to pH.

Acceptable yields from canola and lucerne stands on soils that were once considered too acidic for these sensitive species indicated to Joe that his liming program was working.

Misleading soil pH from 0-10 cm soil samples

Soil test results, using soil samples collected from the traditional 0-10 cm sampling depth, indicated that 20 years of lime application at 'Fairview' had increased soil pH_{Ca} by 1 pH unit to 5.4.

Photo 1. A soil monitoring program and a better understanding of his soil types has prompted Joe to partner with two neighbours in purchasing a variable rate lime spreader.

Feeling reasonably confident that his liming program had acidity under control, Joe said that he was shocked during a paddock walk with Jason Condon and Helen Burns of NSW DPI when a field pH kit indicator on a soil core showed an acid layer at 5 to 15 cm with pH_{Ca} of about 4.6, gradually increasing to above 5.5 at 15-20 cm (Photo 2).

Lime rates, pH targets and monitoring soils for long-term, sustainable production

According to Joe, laboratory tests of soil samples collected 5 cm intervals to a depth of 20 cm that supported the field kit evidence of a narrow band of acidic soil and also showed toxic aluminium levels as high as 7% Al_{ex}, prompted him to review his acid soil management strategy.

"I knew I had to make some changes to stop the subsurface from becoming more acidic and harder to manage." he said.

Although there are no obvious symptoms that acidity is limiting crop yields or lucerne growth, Joe aims to increase pH in the 5-15 cm layer to 5.0 and prevent

further pH decline in those subsurface layers.

"I aim to optimise the environment for the plants and acting now before canola and lucerne show acid soil toxicity symptoms and drop yield makes sense," said Joe.

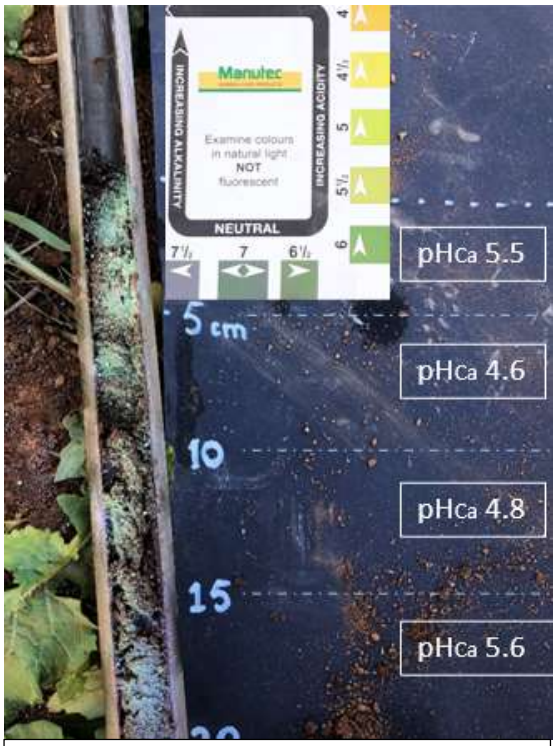

Photo 2. Despite 20 years of lime application, the colour indicator of the soil pH kit showed an acid layer at 5 to 15 cm of the soil profile, demonstrating that topdressed lime has not increased pH below the 0-5 cm layer. **Note**: the Manutec® pH kit indicates pH measured in water, which is 0.8 to 1.0 units more than the commonly used pH_{Ca} values.

"I'll keep monitoring with regular soil testing but will now sample at 5cm intervals to a depth of 20 cm so I can track changes in pH in the subsurface layer," said Joe.

"I need that information to see if the liming program is working, or if I need to make more changes", he said.

Joe believes that the purchase of a variable rate lime spreader with two neighbours will provide more accurate lime application, at rates needed to efficiently achieve pH targets across variable paddocks.

Where layers below 10 cm are acidic that will mean higher rates of fine-grade lime of around 2.5 t/ha, to keep pH_{Ca} in the 0-10 cm layer above 5.5. That is well above the 1t/ha lime rate previously used.

The future

"With land prices going through the roof my priority is managing costs to maximise returns from inputs, but looking to the future, monitoring and managing the soil is an important part of maintaining productivity", Joe said.

Joe said he has followed the acid soil work of NSW DPI and Holbrook Landcare Network and now hosts a lime rate and application experiment at 'Fairview'.

It's one of several sites in southern NSW under the FutureSOILS program, supported by the Australian Government, National Landcare Program. (See the Holbrook Landcare Network website for more details).

Joe said that a soil pit field day on the 'Fairview' experimental site in late 2021 showed that the appropriate lime rate and lime incorporation will fast-track pH change into the acidic layers.

"The better root growth under incorporated lime treatments compared with the surface applied treatments stood out, and I'm interested to know more about how that will effect crop water use efficiency in drier seasons," he said.

"On the strength of the crop response to incorporated lime, I've bought a speedtiller. It is the most practical option for me to get the lime into the subsurface layer where it's needed," said Joe.

For more information:

Condon J and Burns H (2021) Future proofing agricultural production through effective management of acidic soils. In: Southern NSW Research Results 2021, available at https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results

Holbrook Landcare Network: Acid Soils Program. Available at: https://holbrooklandcare.org.au/holbrook-landcare-soils-program/

This case study is part of a project funded by the Holbrook Landcare Network, Grassland Society of NSW and NSW Department of Primary Industries, with financial support from the Australian Government National Landcare Program.

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