

Lucerne acidic soils with high levels of aluminium

GLENMORE STATION – MACKENZIE BASIN

The lucerne trial at Will and Emily Murray's Glenmore Station investigated whether the application of surface lime can increase the pH in aluminium-rich top soil sufficiently to reduce the concentration of plant-available aluminium in this layer, and allow lucerne to penetrate and continue root growth down in the higher pH soils below.

This research was undertaken as part of The New Zealand Merino Company (NZM) and Lincoln University's high country forage project. The overall goal of this work is to improve productivity and sustainability in high country grazing systems.

Impact of soil aluminium

A high level of plant-available aluminium in the soil (more than three milligrams per kilogram) restricts root development and nodulation, leading to poor survival and growth. Restricted root development reduces lucerne's ability to access water from deep in the soil. Further, limited nodulation reduces nitrogen fixation, leaving plants stunted and nitrogen deficient.

Correcting soil pH

Where soils only have a thin aluminium-rich layer, it is possible to correct the pH of the topsoil through lime application, and overcome the negative impact of aluminium in the soil.

At the Glenmore trial site, different rates of lime were applied to test the effect this had on soil pH. As the liming rate increased, so did the pH. Raising the pH above 5.5, and reducing the amount of exchangeable aluminium available in the soil provided a better environment for growing lucerne. The lucerne roots were able to grow deeper, unlocking its productive advantage – accessing water from deeper in the soil.

The photo in figure 1 shows that lucerne plants at Glenmore grew secondary roots that were able to penetrate the top layer of soil, where previously the aluminium concentration had caused forking of the primary roots.

Conclusion

While initial results were positive, the lucerne yield decreased over time, due to a deformed root system and lack of nodulation. Therefore, it is recommended that lucerne should only be sown at sites where soil aluminium levels are below three milligrams per kilogram.



Figure 1: Deeper secondary roots enabled lucerne to penetrate the aluminium layer at Glenmore Station.