NSW GOVERNMENT Department of Primary Industries

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

MANAGING SUBSOIL ACIDITY (GRDC DAN00206)

Amelioration of subsoil acidity using organic amendments

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http://www.dpi.nsw.gov.au/agriculture/soils/acidity

Ripping had a negative effect on crop establishment, particularly in year 1. Deep liming with and without organic amendments increased soil pH and decreased exchangeable Al% significantly at 10-20 and 20-30 cm, but no difference was detected below the depth that soil amendments were placed. There were significant grain yield increases in most organic amendment treatments in year 1, but not in year 2 due to drought. Large volumes of organic amendments required to achieve comparable increases in soil pH compared to lime will likely make their cost prohibitive on a broadacre scale.

Introduction

The site was established in 2018 and compared amelioration effects on subsoil acidity using organic materials, including lucerne hay, pea hay, wheat straw with and without nutrients (NPS), biochar and poultry litter, all pelletised. These were applied with and without lime and placed at 10-30 cm, spaced at 50 cm using the 3D Ripper machine. Reactive phosphate rock (RPR) and lime were also included for comparison.

Site description

The site was located at Holbrook, NSW on a Yellow Chromosol. The initial (2017) pH in $CaCl_2$ was 4.9, 4.2 and 4.6 at 0-10, 10-20 and 20-30cm, respectively, with exchangeable Al of 5.1%, 25% and 7.3% for the corresponding depths. The site was sown to grazing canola in 2018 and grazing wheat in 2019.

Results

There were no significant differences in soil pH, exchangeable Al% and soil mineral nitrogen for the baseline soil sampling (Figure 1), indicating the site was relatively uniform. Averaged across the site, the soil pH was 5.1, 4.1 and 4.2 at 0-10, 10-20 and 20-30 cm with exchangeable Al% of 2.6%, 30.9% and 18.9% at the corresponding depths (Figure 1). The Colwell P was 66.8, 22.3 and 7.1 mg/kg, and soil mineral N was 57.0, 14.8 and 11.7 kg/ha at 0-10, 10-20 and 20-30 cm, respectively.

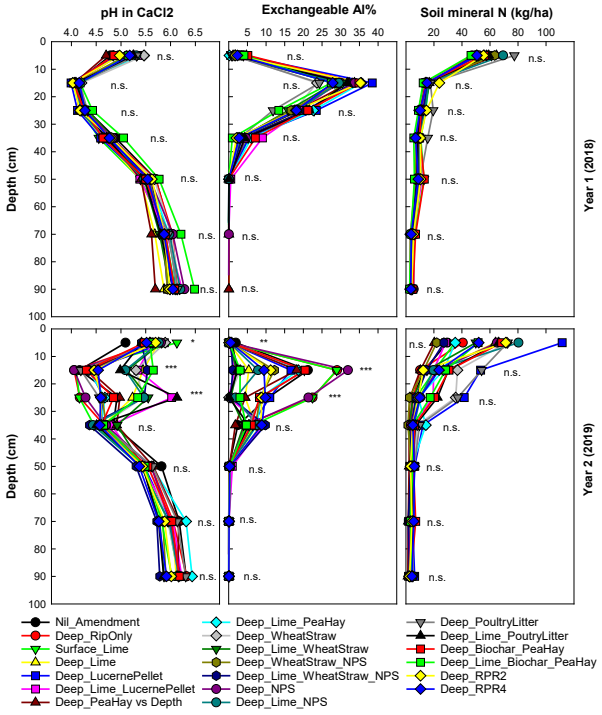

Figure 1. Soil pH in $CaCl_2$, exchangeable Al% and soil mineral N under different soil amendment treatments in 2018 and 2019

One year after treatments were applied, soil pH increased and exchangeable Al% decreased at 10-20 and 20-30 cm where lime was applied at depth, both with and without organic amendments (Figure 1). Deep lucerne hay pellets and deep poultry litter treatments with lime had the highest pH at 20-30 cm, whereas the nil treatment, surface lime and ripping only treatments had highest exchangeable Al% at both 10-20 and 20-30 cm (Figure 1). No treatment difference was detected below 30 cm for either pH or exchangeable Al%. There was no significant difference in soil mineral N between treatments.

There was a significant difference in canola seedling density in year 1, but not for wheat crops in year 2. In year 1, all ripped treatments had lower seedling densities, probably due to the uneven seedbed, and/or increased evaporation associated with the ripping operation.

There was a significant difference in grain yield in both years (Figure 2). In year 1, the lucerne pellet treatment had the highest grain yield in canola (close to 2.0 t/ha) followed by poultry litter plus lime. By contrast, there was a similar grain yield in the limed treatment and nil control (Figure 2). The crop response to organic amendment was due to extra nutrient supply, particularly nitrogen, rather than amelioration of soil acidity. Treatments with lower grain yield in year 1 tended to have higher yields in year 2. For example, both lucerne hay pellets and poultry litter treatments had the lowest grain yield in wheat, whereas deep lime treatment had the highest yield (2.6 t/ha) in year 2. This is probably related to conserved soil water in the lower yielding treatments in year 1 as both years had exceptionally low rainfall.

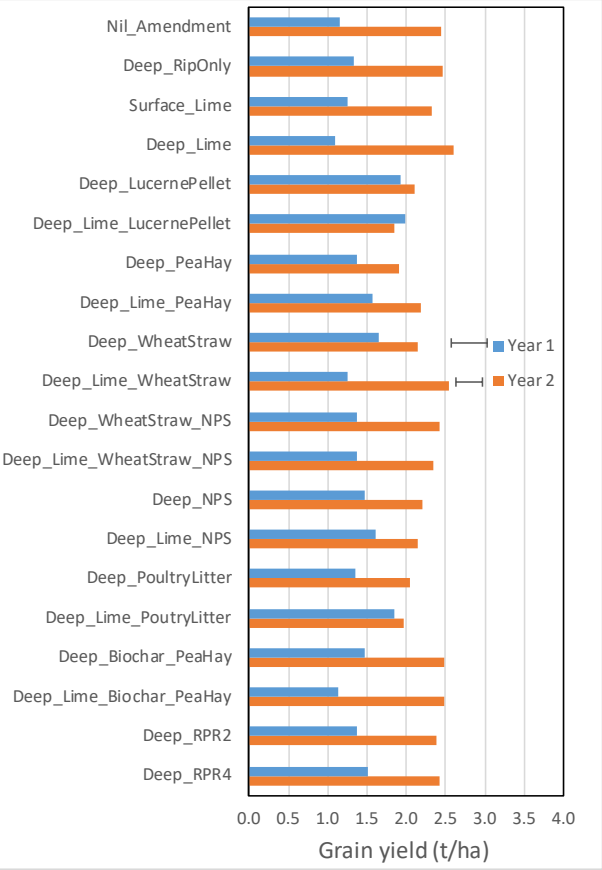

Figure 2 Grain yield under different treatments in 2018 (canola) and 2019 (wheat)

Combinations of lime and organic amendments did not produce a yield advantage at this site over the two years. In general, soil organic amendments increased grain N content but reduced canola oil contents.

Conclusions

Deep liming with and without organic amendments increased soil pH and decreased exchangeable Al% significantly at both 10-20 and 20-30 cm. However, no difference was detected below the depth that soil amendments were placed. Ripping had a negative effect on crop establishment in year 1. Crops had significant yield increases with most organic amendments, particularly for lucerne hay pellets and poultry litter in year 1. However, those treatments with higher grain yield in year 1 tended to have lower yield in year 2, probably due to depletion of soil moisture in year 1. The crop response to organic amendments in the first year was due to extra nutrient supply rather than improvement of soil acidity. Monitoring over a longer period is needed to quantify the residual benefit of the treatments under more favourable seasonal conditions.

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