MANAGING SUBSOIL ACIDITY (GRDC DAN00206)

Amelioration of subsoil acidity using inorganic amendments

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

Deep ripping had an adverse effect on crop establishment and crop yield in the first year regardless of the presence of soil amendments. Both lime and magnesium silicate (a blended product of 70% Doonba dunite and 30% F70 lime) are capable of increasing soil pH and decreasing the exchangeable aluminium (Al%) at the depth where the soil amendments were applied.

Introduction

A deep ripping experiment was conducted on a highly acidic soil to test the effectiveness of a range of inorganic soil amendments on amelioration of subsoil acidity and crop performance over 3 years (2015 to 2017). A novel product, magnesium silicate (MgSi, a blend of 70% Doonba dunite and 30% F70 superfine lime), was tested for the first time in the field.

Site description and treatments

The site was located at Holbrook, NSW. The soil was a Yellow Chromosol. The initial pH was 4.9, 4.2 and 4.6 in $CaCl_2$ 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 Hyola® 970CL canola in 2015 and EGA Wedgetail⦶ wheat in both 2016 and 2017.

There were 9 treatments with 3 major contrasts, a) surface vs. deep application; b) lime vs. MgSi vs. gypsum; c) surface application of urea vs. $Ca(NO_3)_2$ under deep ripping. The soil amendments were applied in 2015 and placed at approximately 20-30cm depth using a single tyne ripper with a manual feeding system.

The initial soil samples were taken before treatments were implemented in 2015 to a depth of 100 cm, two cores (44mm in diameter) per plot composited every 10 cm to a depth of 0-40cm and every 20 cm at 60-100cm. Subsequently, in year 3, the soil samples were taken using a multi-corer (6 tubes with 25mm in diameter) to a depth of 60cm, 2 locations per plot, composited with corresponding depths. Seedling density, crop biomass and grain yield were measured for each crop over 3 years.

Results and discussion

Deep liming and Deep MgSi significantly increased soil pH and decreased exchangeable Al% at 20-30cm where soil amendments were placed compared to the Control treatment 3 years after treatments were implemented. However, no significant differences were found between Deep liming and Deep MgSi treatments for either soil pH or exchangeable Al% (Figures 1 and 2). At 10-20cm, soil pH was higher and exchangeable Al% was lower in the Deep MgSi treatment than those in the Control treatment, but no differences were found between Deep liming and MgSi treatments for either soil pH or exchangeable Al%. Further research is required to explore whether MgSi is more efficient in decreasing Al toxicity than lime. Deep placement of gypsum had no effect on soil acidity, as expected.

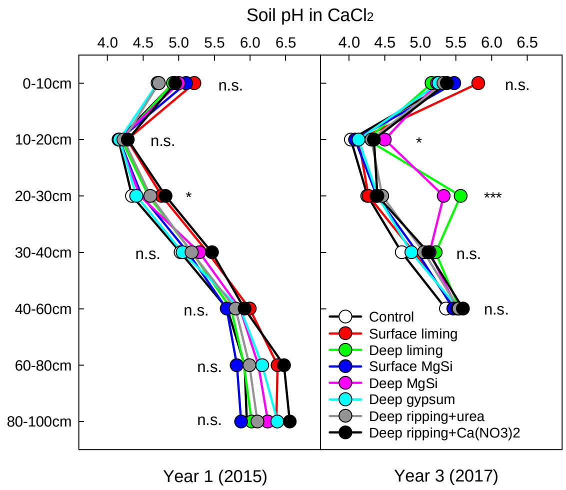

Figure 1. Soil pH in $CaCl_2$ under different soil amendment treatments in autumn in years 1 and 3

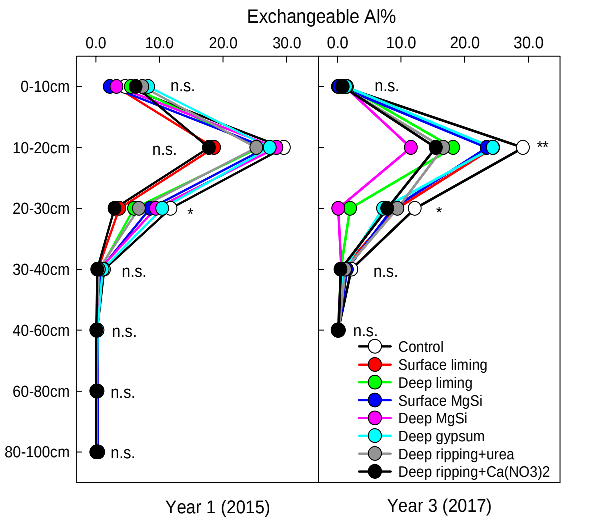

Figure 2. Soil exchangeable Al% under different soil amendment treatments in autumn in years 1 and 3

There was a significant difference in seedling density for the canola crop in year 1 only, but not for wheat crops in years 2 and 3 (Figure 3). 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 similar trend for seedling density in year 2, but not in year 3.

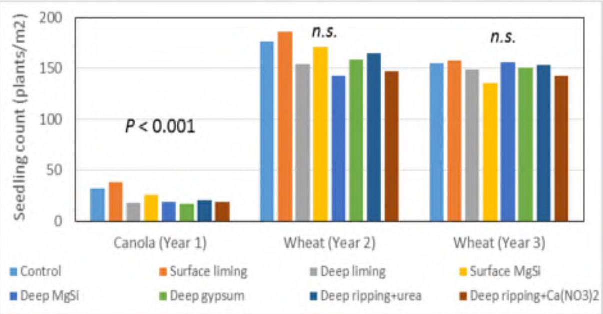

Figure 3. Seedling density (plants/m^2) at crop establishment in response to different soil amendments in years 1-3

At crop harvest, Surface liming and Surface MgSi, including the Control treatment, had significantly higher yield than Deep liming, Deep MgSi, Deep gypsum treatments (Figure 4). No difference was found in wheat grain yield in year 2, most likely due to ample in-crop rainfall in spring of 2016. In contrast, the $Ca(NO_3)_2$ treatment in year 3 had a significantly higher yield than the remaining treatments (Figure 4), presumably due to less nitrogen volatilisation losses that would occur with urea application.

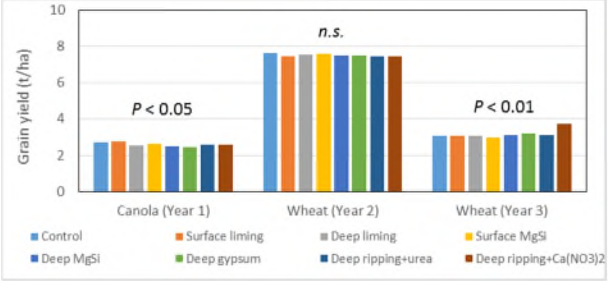

Figure 4. Grain yield (t/ha) in response to different soil amendments in years 1-3

Conclusions

The deep ripping operation had an adverse effect on canola establishment and crop yield in the establishment year, but no yield penalty was observed in the wheat crops in years 2 and 3. Deep placement of lime and MgSi increased soil pH and decreased exchangeable Al% significantly at 20-30 cm where soil amendments were placed. However, no significant differences were found between Deep liming and Deep MgSi treatments for either soil pH or exchangeable Al%. Deep placement of gypsum had no effect on soil acidity and no improvement on grain yield at the current site.

Acknowledgements

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