Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Liming by incorporation – six years on

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Key findings

- Liming decreases surface soil acidity.
- The incorporation of lime increased the movement of the lime to the 10-20cm layer neutralising subsoil acidity.
- Subsoil aluminium levels at this site fit WA relationships that toxic Al above 2 mg/kg occur when pH (CaCl2) is below 4.5

Introduction

This trial shows that lime incorporation to depth is required to rapidly change subsoil pH. This long term lime trial was established in 2013 on John Iffla's property 23km WNW of Bremer Bay. The annual rainfall for this site is 550mm and the soil is sand and gravelly sand over gravel with clay at a depth of 30-40cm.

Paddock History

The paddock had received 3t/ha of lime in the 5-6 years prior to 2013 however there was no apparent change in pH. Prior to establishing the trial in 2013 there was a further 1t/ha spread over the whole paddock. The rotation of the paddock is as follows; 2013 wheat, 2014 canola, 2015 barley, 2016 canola, 2017 barley, 2018 oats, 2019 canola. The paddock was performing below its potential and is non-wetting.

Table 1. 2013 pH ($CaCl_2$) profiles before trial establishment. Shaded pH values are at or below target levels for the layer.

Soil depth (cm)	site A	site B	site C	site D
0-10	4.9	4.7	5.0	4.7
10-20	5.5	4.8	4.5	4.6
20-30	5.7	6.8	4.9	4.7
30-40	6.4	6.8	5.5	
40-50	6.7			
50-60	6.3			
60-70	6.5			

From the pH results taken from sites A (outside of trial), B, C and D (locations shown in figure 1) in 2013 the 0-10cm topsoil was acidic as all locations were under the target pH of 5.5. The subsurface pH was sitting around the target pH which is 4.8.

Method - trial establishment

The trial is split plot design with lime application rates of 1t/ha, 11t/ha and 17t/ha replicated twice. A separate area just north of the replicated experiment as spread with 6t/ha making 7t/ha in total for 2013. A coarse local lime was used with an effective neutralising value of approximately 45 per cent, which is the reason for the high rates. There are still undissolved particles of lime visible confirming the coarse nature and

high lime rates used in the experiment. Half of each plot was cultivated in autumn 2016 with Grizzly offset tandem discs to about 20cm.

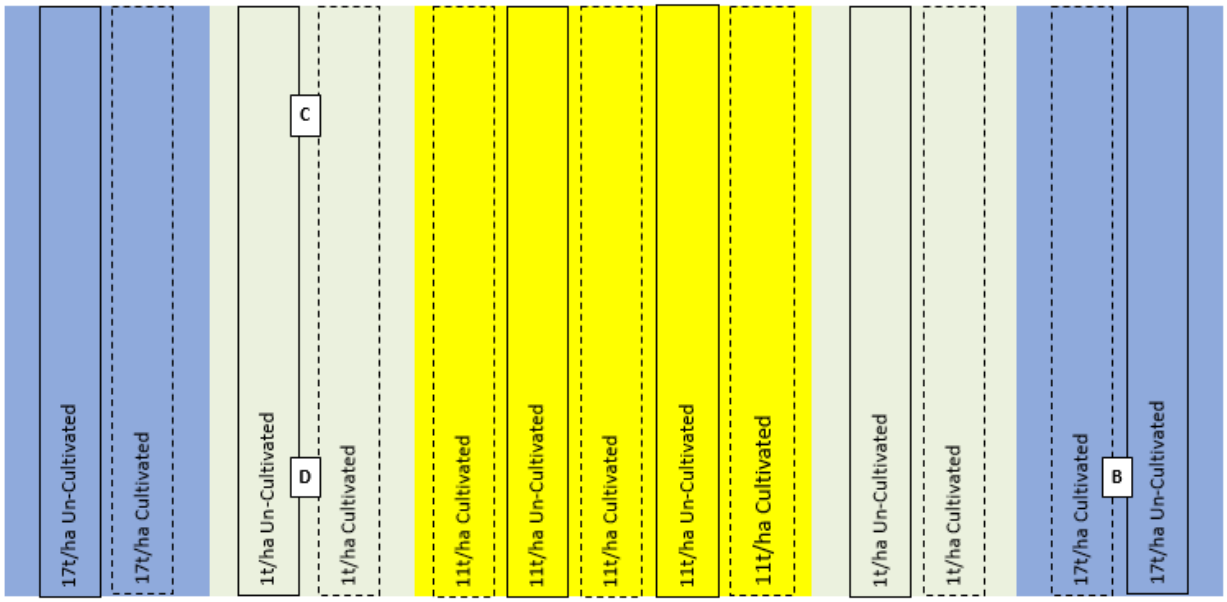

Figure 1. Layout of the trial and the 2013 pH sample points.

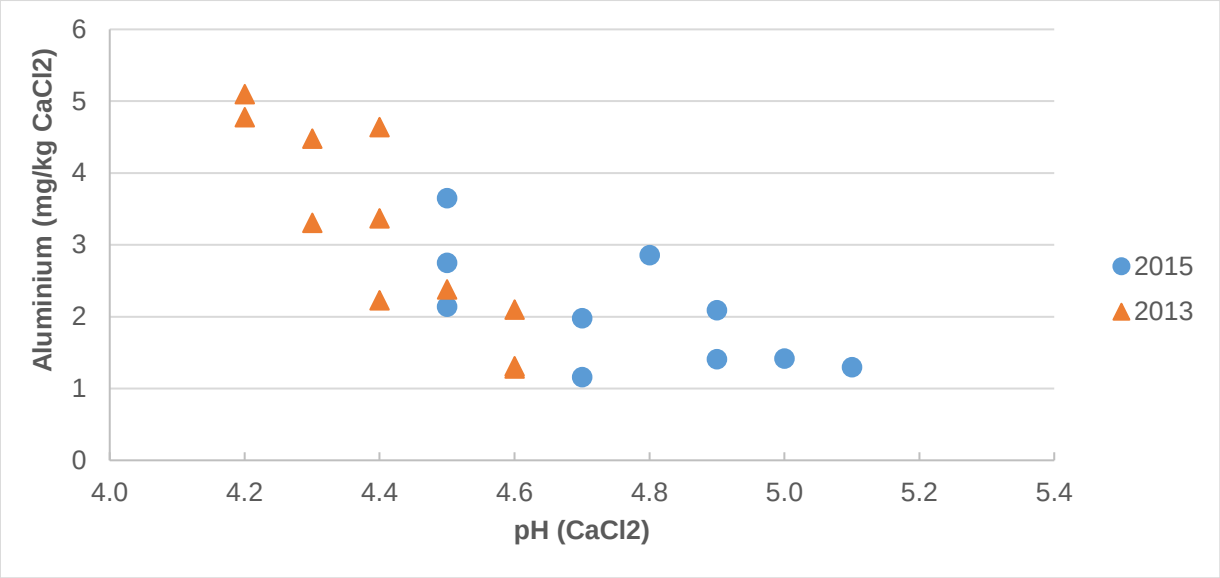

Figure 2. Relationship of Al (CaCl2) to soil pH in 10-20cm layer.

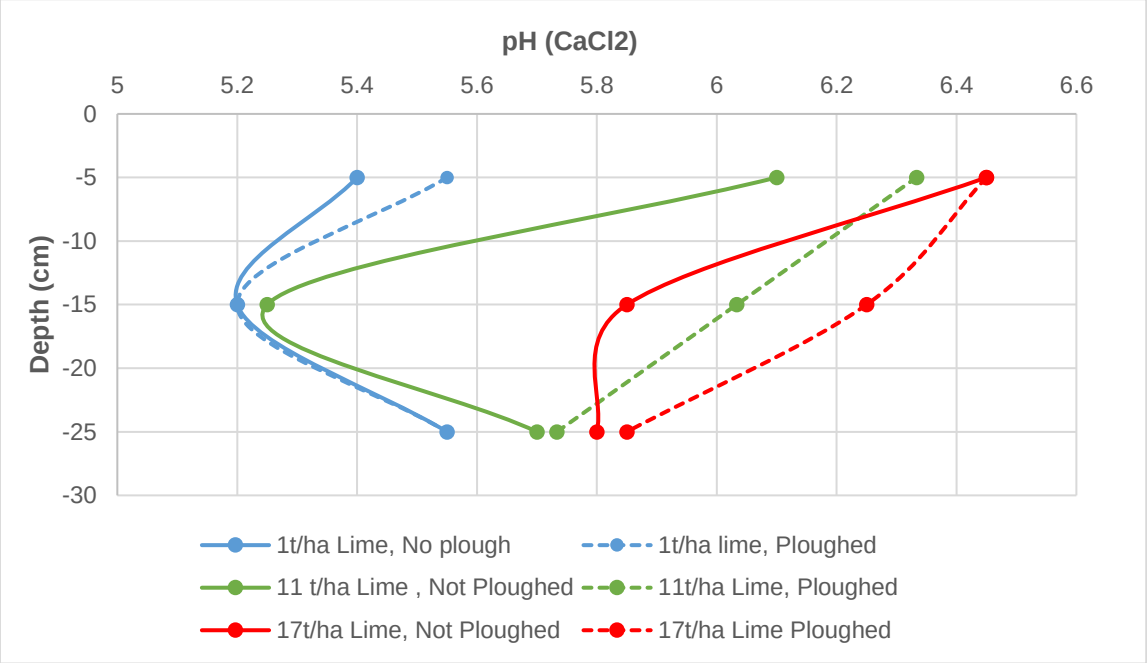

Figure 3. pH (CaCl2) at 0-10cm, 10-20cm and 20-30cm in May 2019 for 1t/ha, 11t/ha and 17t/ha of lime applied in 2013 and ploughed or unploughed in 2016.

Discussion

Sandy gravel soils in the high rainfall zone are prone to subsoil acidity as they have a low buffering capacity and are prone to nitrate leaching due to low water holding capacity of surface layers. This long term trial has demonstrated that the higher the lime rate the higher the pH will be and ploughing mixes lime to depth neutralising subsoil acidity. At 0-10cm the pH increased for the 11t/ha and 17t/ha lime not ploughed when compared with 1t/ha lime treatment.

Offset disc ploughing to 200mm incorporated lime and increased 10-20cm pH at both 11 and 17 t/ha applied. Interestingly in the absence of cultivation at the 17t/ha lime rate the soil pH at 10-20cm appears to have increased however this was not the case for the 11t/ha lime not ploughed. This may be due to contamination from surface soil into subsurface samples because of the dry conditions in May when samples were taken.

Conclusion

Applying lime to the soil surface decreases soil acidity on the surface and just below. When it is incorporated into the soil it also decreases subsoil acidity. This sandy gravel site over time has demonstrated that the higher the lime rate the higher the pH will be and ploughing mixes lime to depth neutralising subsoil acidity.

Acknowledgments

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