

Soil pH Micro-variation Mapping

Background

Farmers usually collect top-soil (0-10cm) samples when determining if they need to lime, but soil pH can be quite variable down the soil profile. Will a single sampling depth show up this inherent variability? To then further complicate the issue, most farmers usually broadcast lime as the paddock is either in permanent pasture or under minimum tillage in crop. However, we know that lime moves slowly through the soil profile and KI data indicates limited movement below 5-10cm.

This raises many questions:

- Are our soils acidifying at depth, and if so will this impact on crop and pasture growth?
- What happens when we just apply lime to the top soil?
- Do we need to be re-thinking our liming program?

The widespread adoption of minimum tillage will have impacts on how we manage soil acidity. The current standard industry practice of spreading lime, with no incorporation under minimum till systems, confines the lime benefits to the surface layers. There is a range of options to get lime to depth under minimum or no-till operations that farmers may need to now consider:

- Applying high rates of surface applied lime to drive the leaching of lime down the soil profile.
- Incorporating lime into sub-surface or sub-soil using specialised machinery.
- Delving or spading to help move lime or help mix less acidic soil horizons.
- Use of strategic tillage to more thoroughly incorporate the lime.

What was done

Two cropping sites were selected on R & K Stanton and Sons “Caledonia” property on Timber Creek Rd, Hundred of Seddon. Both sites were sampled

on the 4th June 2018. At each site, four mini (soil) pits were dug approximately 50 cm apart. In each mini pit, five 4 cm wide cores were taken, two under each seeding row and three cores between the seeding rows. Each core was subsampled into 2.5 cm increments down to 15 cm, bulked and analysed for soil pH.

Site 1:

- Canola stubble 8” spacings
- Limed 2009 and 2016 @ 2.5t/ha
- Continuously cropped since 2006
- Zero till since 2010
- Soil – loamy ironstone over clay. Clay at about 30 cm (below sampling depth)

Site 2:

- Canola stubble 8” spacings
- Limed 2009 @ 2.5t/ha
- Continuously cropped since 2006, except in 2016 when it was sown to Balansa clover
- Zero tillage since 2010
- Soil – loamy ironstone over clay. Clay at about 30 cm (below sampling depth)

Results

At Site 1 the results show limited lime movement below 5 cm, even after 2 lime applications (refer to **Table 1**). This correlates with other monitoring work on Kangaroo Island and the mainland, which indicates that broadcast lime does not move much below about 5 cm at normal application rates of 2.5t/ha. Only the top 2.5 cm of top soil has pH readings considered adequate for crop growth, with some lime movement into the 2.5 to 5 cm layer but still below desirable levels.

The results indicate a distinct “acid throttle” between 5-10cm. An acid throttle occurs when there is a layer of soil with low pH that would be

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sufficient to restrict root growth, thus limiting the crop's access to water and nutrients.

Site 2 (**Table 2**) was limed over nine years ago and the results are showing that re-acidification has now occurred in the top soil. In essence, the acid throttle is now the full top 10cm of soil.

These results indicate the need for regular liming to increase and then maintain soil pH. Site 2 had completely re-acidified in nine years. The results also highlighted the limited movement of lime down the profile. Traditional 0-10 cm soil sampling post liming may give a false result by indicating a pH increase through the top soil when in fact, it's only the top 2.5 cm that has increased in pH.

Farmers need to be aware of this and sample pH at greater depths. A quick check may be to dig a quick a hole (just with a shovel will be fine) down to 20 cm and test the pH with a garden soil pH kit. This will quickly highlight the soil pH to depth and the potential for any acid throttles.

If an acid throttle is detected i.e. a zone of soil with a pH of less than 5 in the top 20 cm of soil, other liming strategies will need to be considered. This may involve an increase in rate and/or frequency of lime application, but be aware of the risk of over-liming and inducing nutrient deficiencies, especially Manganese. Otherwise, you may need to consider a once off strategic tillage to fully incorporate the lime.

Table 1: Soil pH results from site 1.

Note column headings are the distance from the first seeding row.

Depth/Width (cm)	Seeding Row	3-7cm	8-12cm	3-17cm	Seeding row	Mean down
0-2.5	5.61	5.52	5.62	5.62	5.74	5.6
2.5-5	4.65	4.76	4.81	4.81	4.74	4.8
5-7.5	4.38	4.38	4.51	4.51	4.13	4.4
7.5-10	4.45	4.43	4.42	4.42	4.32	4.4
10-12.5	4.67	4.61	4.61	4.61	4.59	4.6
12.5-15	4.79	4.81	4.74	4.74	4.74	4.8
Mean across	4.8	4.8	4.8	4.8	4.7	

pH	
>6	
5.5-5.9	
5.0-5.4	
4.5-4.9	
4.0-4.4	

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Table 2: Soil pH results from site 2.

Depth/Width (cm)	Seeding Row	3-7cm	8-12cm	3-17cm	Seeding row	Mean down
0-2.5	4.49	4.13	4.29	4.51	4.35	4.4
2.5-5	4.58	4.08	4.05	4.1	4.05	4.2
5-7.5	4.14	4.16	4.14	4.18	4.07	4.1
7.5-10	4.32	4.37	4.43	4.46	4.28	4.4
10-12.5	4.67	4.73	4.74	4.69	4.55	4.7
12.5-15	4.9	4.92	4.93	4.82	4.8	4.9
Mean across	4.5	4.4	4.4	4.5	4.4	

Take home messages

- Monitor pH to depth by using a shovel and cheap pH test kit
- Don't assume just because you once limed that the problem is solved – monitor, monitor, monitor
- Consider options to get lime to depth by increasing the rate and/or frequency of liming or using strategic tillage

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DEW

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