

SOIL pH MICRO-VARIATION MAPPING - KI

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, 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:

- Apply high rates of surface applied lime to drive the leaching of lime down the soil profile.
- Incorporate 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 T & F Fryars & Sons property on Hog Bay Rd, Hundred of Haines. Both sites were sampled on the 21st May 2020. 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:

- Barley Stubble 9" spacings
- Limed in 2018 at 2.5t/ha limesand
- Continuously cropped by the current owner since 2013. Cropped by the previous owner for at least 5 years prior to that and possibly limed during that time.

- Paddocks are direct sown using knife points since 2013 and minimum tillage used by previous owner
- Soil - sandy loam graduating to a yellow sandy gravel layer. Orange clay at 30 cm

Site 2:

- Barley Stubble 9" spacings
- Limed in 2018 at 2.5t/ha limesand
- Continuously cropped by the current owner since 2013. Cropped by the previous owner for at least 5 years prior to that and possibly limed during that time.
- Paddocks are direct sown using knife points since 2013 and minimum tillage used by previous owner. Paddock was delved approximately 10 years ago
- Soil – loamy sand over bleached white sand, gravel layer at about 18cm, orange clay at 30 cm

Results

At **Site 1** the results show limited lime movement below 5 cm (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.

Site 2 (TABLE 2) although limed at the same time as Site 1, is showing a distinct "acid throttle" between 5 -12.5 cm. An 'acid throttle occurs when there is a layer of soil with low pH that would be sufficient to restrict root growth and thus limiting the crops access to water and nutrients.

pH key

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

TABLE 1: soil pH results from Site 1 – Note column headings are the distance from the first seeding row.

Depth/width (cm)	Seeding row	6 – 12cm	12 - 18cm	18 – 23 cm	Seeding Row	Mean Down
0-2.5	5.72	5.74	5.54	5.37	5.69	5.6
2.5-5	5.14	5.51	5.52	5.11	5.35	5.3
5-7.5	4.9	4.99	4.96	4.92	5.15	5.0
7.5-10	4.99	4.86	4.72	4.71	4.98	4.9
10-12.5	5.24	5.15	4.81	4.86	4.9	5.0
12.5-15	5.57	5.56	5.31	5.24	5.05	5.3
Mean across	5.3	5.3	5.1	5.0	5.2	

TABLE 2: Soil pH results at Site 2 - Note column headings are the distance from the first seeding row

Depth/width (cm)	Seeding row	6 – 12cm	12 – 18 cm	18 – 23 cm	Seeding Row	Mean down
0-2.5	5.3	5.34	5.34	5.37	5.31	5.3
2.5-5	4.55	4.9	4.8	5.25	4.82	4.9
5-7.5	4.42	4.41	4.33	4.68	4.51	4.5
7.5-10	4.36	4.26	4.24	4.38	4.38	4.3
10-12.5	4.52	4.42	4.29	4.42	4.39	4.4
12.5-15	4.54	4.56	4.6	4.61	4.59	4.6
Mean across	4.6	4.6	4.6	4.8	4.7	

These results indicate the need for regular liming to increase and then maintain soil pH. 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.

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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