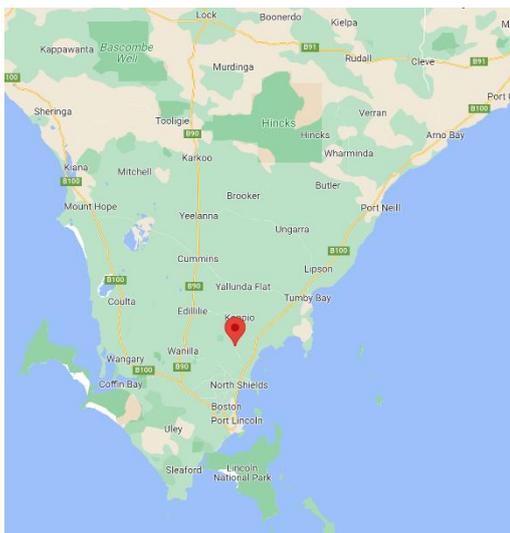


Regenerative Agriculture Program restoring soil pH case study: Macdonald, Whites Flat/Koppio

Key messages

- Rotational liming is a long-term method of addressing acidity across the whole farming system.
- Multiple benefits are seen in the rotational liming approach for weeds, nutrition and legume crops.



Whites Flat on the Eyre Peninsula.



Derek Macdonald at home at Whites Flat.

Background

- Mixed farm with Derek, dad, brother and a worker.
- Home farm at Whites Flat/Koppio with lease blocks at Wanilla and Winters Hill, a range of country across the Lower Eyre Peninsula.
- Average rainfall 450–500mm.
- Soil type is predominantly dark, heavy, ironstone gravel soils, Wanilla and Winters Hill are sandier but lots of variation of soil types across the whole farming system.
- 2,450ha cropped – wheat, canola, lentils and beans.
- 1,400 merino ewes on un-arable country they own, feedlot white Suffolk cross merino lambs.

In 2012, Craig Davis from the Mid North was employed by the farm to help take the business to the next level, taking a whole farm approach. At this point surface soil pH was 5, and unknown to the Macdonald's the subsurface pH decreased to pH 4.5 with a clay layer at depth. Aluminium toxicity

was becoming a real issue in some areas, reducing drought tolerance and fertiliser to yield conversion. Some areas would die off in wet seasons, clearly under stress due to this subsurface acidity weakened root systems. Derek subsequently attended some of the soil acidity events held as part of the EP Landscape Board’s Regenerative Agriculture Program, to increase his understanding of soil acidity management.

Rotational liming

The Macdonald’s started implementing a rotational liming and gypsum plan to address the acidification issue. This approach has been tested and fine-tuned across the 11 years that they have been doing this. As described by Derek, “Rotational liming is applying lime with the cropping rotation and taking that into consideration in how your whole farm is humming along at that time.”

In practice, this looks like liming in front of legumes and canola to benefit their rotation. In a wetter year, bad aluminium toxicity and other problems still start to show, whereas in an average year, the side effects of acidity are not as evident.

When they started, lime was applied at 3 t/ha blanket rates. Today 11 years on, soil surface pH is 7 or nearing 7 across the properties. The priority initially was to act quickly to fix soil acidity - now the program has stabilised with 1 t/ha application of lime every few years. In the future, rates may be even lower just to keep the soil pH at neutral. Over time, these surface applications are moving down the soil and starting to increase pH in the subsurface. Derek has observed better fertiliser uptake, moisture holding capacity and stronger root structure in all crops grown over all the properties year by year.



Strong and healthy wheat root system at Whites Flat.

Continual monitoring and pH measurement

For the rotational liming system to keep working, the Macdonald’s are continually monitoring their soil pH. They have done some pH mapping and found at Koppio the surface pH is neutral (7-8) but then digging down and still finding subsurface acidity. One way of assessing the subsurface issues is a 1m soil core test, then using the field pH kit to measure pH down the soil profile – the Macdonald’s get this done when their agronomist does their deep nitrogen testing. While this doesn’t necessarily relate to a whole farm or paddock, an approximate indication goes a long way in helping to decide where lime needs to keep being applied.



Example of taking a core sample and using the field pH kit to test soil acidity.

Effects of adapting the rotational liming method

Implementing the rotational liming method has brought about many positive results in the Macdonald farming system.

Legumes

A major impact of the liming program has been the increased legume production. Beans and lentils thrive without the threat of aluminium toxicity in the acid soils. Legumes fit as the buffer needed in crop rotation for sustainability in continuous cropping, along with grass weed control, so liming works perfectly in the rotation to boost legume production in that season.



Common Whites Flat soil type showing clay layer.

Increased legume production also means boosted nitrogen input into the soil which is carried over for the next crop. This is significant as the Macdonald's prioritise economical fertiliser applications with targeted yields based on their reliable yearly rainfall. This ensures that input costs are optimised while also securing the highest yield potential.

Weed control

After liming, some patches of weeds have disappeared from historically weedy areas. One spot was grassy when the rotational liming started, now that area has completely disappeared. While this isn't the norm for every ryegrass area, Derek attributes examples like this to improved crop competitiveness from the liming applications. Ryegrass can appear to be the problem in an area but that is only because the crop plant is weakened from its acidic soil base. Abating acidity by applying lime helps the crop to grow stronger initially and then can compete better with ryegrass germinations.

Trace elements

Before starting this approach, leaf, sap and soil tests were highly varied and many trace elements were consistently deficient. Now testing shows stability in the trace elements and minimises the need for specific applications for one or two minor trace elements. One example of this is molybdenum - levels used to be very low but now it's consistently at the right levels needed for N uptake.

At the Wanilla block, manganese deficiency was visually seen and confirmed with leaf testing, especially evident where lime mounts were dumped in field. This was easily fixed with a normal zinc, manganese, copper (ZMC) application. The Macdonald's have found that these sandy, non-wetting soils buffer differently and still have lower pH at depth from fertiliser history. The manganese issues caused by lime applications are easily fixed and Derek acknowledges that addressing acidity at Wanilla is just a slower process.

What they've learnt overall

Through all they've learnt from rotational liming so far, Derek's advice to other farmers who may be considering the same approach is they really need to know their own soil types and look for science to explain what the issues could be, and back that up with soil and plant tissue tests. A plant test will show a different picture to a soil test in the same spot because of what the plant can or cannot

access from the soil. Derek suggests “go in slowly to address the issue and tread water with personal on-farm trials, then fully head in”.

Attacking the root of the acidity issue has also been important to the Macdonald’s. On the home farm (Whites Flat/Koppio) they stopped using sulphate of ammonia, due to its high acidifying properties, and they now use natural gypsum to meet that sulphur need. Derek says in higher rainfall farming systems, look for crops you can grow that fix natural nitrogen in the system.

Strategy for the future

Derek is keen to keep doing what they are doing, seeing so many amazing benefits and is happy with the results they already have. Liming isn’t too expensive - the Macdonald’s can justify that cost even on leased ground after seeing so many good results, and say it is a simple and cost-effective option.

Derek believes liming is important in the system to get soil working properly, especially he says with fertiliser being expensive, the crop needs to be able to fully utilise that with strong root systems. Remembering that granular fertiliser is washed in and converted to plant available forms before the plant even has access to it, if soil and plants are sick in some way then urea may not be getting fully utilised. It is a combination of the whole farming system, not just one thing.

In the future, the Macdonald’s may get to a stage that they only need to do variable rate lime based on pH surface maps but for now are continuing to monitor acidity. Fertiliser is still needed in their system so lime is also still needed to ensure that acidification is slowed as much as possible. Until there is a natural fertiliser that is economically and nutritionally viable similar to synthetic fertiliser used now, Derek says that monitoring is still needed to ensure that their fertiliser and liming systems are working together for the whole farming operation.

Acknowledgements

Thank you to Derek Macdonald for sharing his story.

This [Regenerative Agriculture Project](#) is delivered by AIR EP and is supported by the [Eyre Peninsula Landscape Board](#), through funding from the Australian Government’s [National Landcare Program](#).

Information collected in June 2023.

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