

Name of Project:	Trial to measure the benefits of soil moisture and pasture growth from deep cultivation at Strathbogie
Address of trial site	Strathbogie 3666
Organisation delivering trial	Strathbogie Tableland Landcare Group – Soil Trial Subcommittee
Fund source	Climate Change Adaptation in Ag
GB CMA contact	Karen Brisbane-Bullock
Period trial conducted	April 2021 – September 2022
Trial objectives	<p>Strathbogie Tableland SoilCare Group developed a demonstration site to investigate the effect of deep cultivation of compacted sub-soil on the Strathbogie Tablelands with the expectation that ripping the ground will open the sub-soil to retain higher levels of moisture and enable perennial grasses with deep root penetration to produce productive pastures.</p> <p>Farmland in Strathbogie Tableland surrounding areas is highly acidic with shallow topsoil over a hard granitic ‘pan’ sub-soil. These attributes of our soil structure restrict the growth and quality of grasses and limit farming enterprises. The hard ‘pan’ is also limiting the capture and storage of soil moisture. This project investigated ways to break up the hard ‘pan’ which should increase moisture levels in the sub-soil and encourage deeper root penetration of grasses.</p>
Site History	<p>The current owners purchased the property in 2013. The property had minimal lime or fertilizer applied and heavily stocked for 15 years.</p> <p>The current owners undertook soil testing in 2013 and developed a plan to improve pastures on the property. This plan involved spraying out weeds and growing annual grasses and clover to try to rid the paddock of weeds and less valuable grasses.</p> <p>Over a progression of years from 2014 the owners applied lime and sowed both annual and perennial grasses with the aim of establishing a permanent pasture – with poor results.</p> <p>Until 2017 soil testing had only been undertaken in the top 10cm of the paddock. In Autumn 2017 soil tests were taken 0 – 10cm and 10 – 20cm, with the results showing that while the pH in the 0 – 10cm samples had improved slightly from 4.1 in 2014 to 4.5 in 2016. The 10 – 20cm results showed that the pH had not changed from 4.1 - 4.2.</p> <p>Further liming and the application of gypsum were undertaken from 2018 to 2020 with Lime and Gypsum applied at a rate of 2.5tonne/ha.</p> <p>In 2021 it was decided to undertake soil tests at every 10cm to a depth of 70cm. These tests clearly demonstrated that while there had been an increase in pH in the 0 – 10cm over the previous 7 years, below 10cm the pH was still around 4.1 – 4.2 range. These results showed that after 6 years of treatment in this paddock, we had little impact of our soil pH below 10cm. These results created discussion about whether deep ripping would open the sub soil to allow lime to penetrate deeper into the soil profile.</p>



Above: Demonstration site in March 2021 prior to work commencing.

Trial site information

The 0.7Ha site was fenced and the paddock grazed by sheep and then sprayed out completely in April 2021.

Soil sampling was taken to assess the acidic levels of the soils on the demonstration site at 10cm intervals to a depth of 70cms by Ag Victoria, samples were sent to EAL for analysis in May 2021.



Above: Brad Costin and Peter Righetti taking a 70cm soil core and core sample on the right

The demonstration site was created in June 2021 in a paddock in Strathbogie.

The trial site was divided into 25 'plots' each approx. 324sqm (please see attached plan below):

- 5 plots were the 'control' - not cultivated.
- 10 plots were deep ripped to a depth of approximately 40cms with a chisel plough which is specially designed to crack and 'open up' the sub-soil (see photo below).
- 10 plots were both deep ripped and then lightly cultivated.



Above: Cultivation down to 40cms average in June 2021

Across the 25 plots the following treatments were applied in September 2021:

- 5 plots were not cultivated and planted with a permanent pasture seed mix of Phalaris and Chicory.
- 5 plots were treated with palletized Lime (5t/Ha) and sown with a permanent pasture seed mix of Phalaris and Chicory.
- 5 plots were treated with poultry manure @ 800kgs/Ha and sown with a permanent pasture seed mix of Phalaris and Chicory.
- 5 plots were planted with vetch at the rate of 210kgs/Ha in early winter which was cultivated into the soil prior to sowing the permanent pasture seed mix of Phalaris and Chicory.
- 5 plots were treated with poultry manure pellets @ 210kgs/Ha planted with field peas in early winter and then cultivated into the soil prior to sowing with a permanent pasture seed mix of Phalaris and Chicory.

The permanent pasture seed mix that was sown into the demonstration site consisted of SF Punter Chicory sown at 2.5kgs/Ha and Barenbrug Advanced AT Phalaris sown at 6kgs/Ha.



Above: Sowing seed mix across all plots in September 2021

We monitored the demonstration site to establish a baseline of soil moisture levels to determine whether different soil treatments will retain soil moisture. Since sowing the site in June 2021, the soil has been saturated and soil moisture was not measured.

An important aim of this trial is to share our knowledge and data from the trial as widely as possible.

Measurements

Using a deep soil sampler, 70cm soil cores were taken by Brad Costin (Ag Vic) and Peter Righetti in May 2021.

Th soil test results from the 0-70cm samples can be viewed below in a table.

Visual pasture assessment was completed by Peter over the period of the demonstration site. In early October 2021 growth was sparce across the site, Chicory was prominent at about 6cm, clover was just appearing at 2 leaf stage and Phalaris was sparce at a height of about 10cm.



Above: Trial site in October 2021

The germination was less than 30% and discussion was held about what management should be taken. The site was left to see what established.

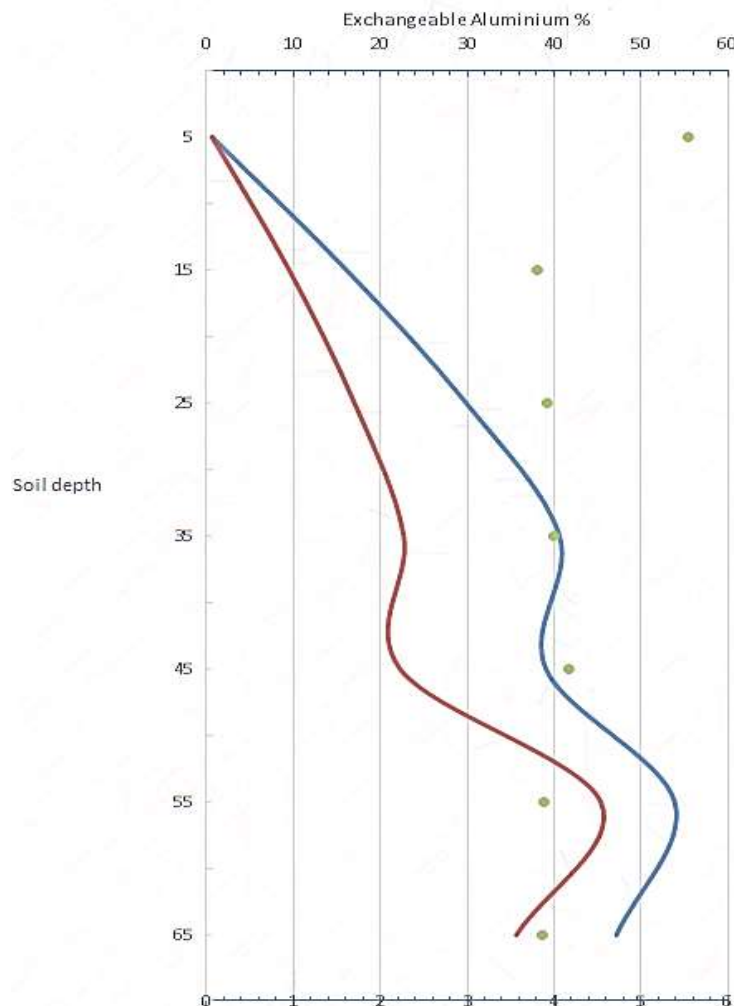
In late November, the pasture growth on parts of the demonstration site were at knee height. With Vetch and Chicory prominent and clover growing at ground level sparsely in late November 2021. **Photo below.**



It was decided to crash graze the site in December 2021 to allow for better growth of the clover.

Results

The graph below shows Exchangeable Aluminium % and pH CaCl₂. The blue line is exchangeable Aluminium % using an exchangeable acidity test. Red line is what we got using this specific approach using the CEC test. Whilst the Aluminium % levels are elevated in our improved testing; they can be up to 50% less. The bottom axis is pH levels the pH is plotted using green dots which shows how the pH influences the approach. When pH is high, there is no difference in Aluminium.



Conclusions

Soil testing – traditionally, soil tests have been taken from the top 10cms of the soil profile. Our deeper tests showed in the granitic soils of the Strathbogie Tablelands, pH varies markedly with depth. Our initial core sampling for this trial, undertaken in May 2021, showed a pH of 5.55 in the 0 – 10cm soil test but then 3.81 in the 10 – 20cm test. Most plants and grasses that grow in the top 10cm would do fine with a pH of 5.55 but as we tried to introduce perennial species that grow roots to deeper depths, the highly acidic subsoil was a major problem.

Lime penetration – our trial showed that it is possible to increase pH at depth but the cost of doing so makes it a marginal exercise financially. The trial paddock had been limed three times since 2014 – each time at 1T/Ac – with little pH response, particularly at depth. By using pellatised lime and sowing it into the soil we were able to make some pH impact on our sub-soil but the quantities required and cost of doing so makes the exercise marginal.

Deep Ripping – we have concluded that in this soil type deep ripping is not justified. We have experienced two particularly wet years and our granitic sub-soil has remained wet and soft throughout most this whole trial. Under these circumstances our efforts to ‘open up’ the subsoil to allow extra moisture and lime penetration have shows very limited results.

Soil test results 2021-2022

Macsfield Park	2021 - trial site before works commenced							2022 - tests after lime treatment														
								Control Av				Limed but not ripped				Limed and ripped						
testing depth (cm)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	0-10		10-20			0-10		10-20		0-10		10-20			
pH (1:5 CaCl2)	5.55	3.81	3.92	4.00	4.17	3.88	3.87	5.84		4.85			7.00		5.25		6.55		5.10			
								Actual results below														
								0-5	5-10	10-15	15-20		0-5	5-10	10-15	15-20	0-5	5-10	10-15	15-20		
								6.37	5.3	5	4.7		7.2	6.8	5.6	4.9	7.2	5.9	5.4	4.8		
												Lime Calcipril 2T/Ac applied										

Site Plan for Strathbogie acidic soils demonstration site below

	Row 1 (18m)	Row 2 (18m)	Row 3 (18m)	Row 4 (18m)	Row 5 (18m)	
Bay 1 18m	Deep Ripped only	Deep ripped and lightly cultivated	No Deep ripping	Deep Ripped only	Deep ripped and lightly cultivated	Sow Perennial pasture seed mix
Bay 2 18m	Deep Ripped only	Deep ripped and lightly cultivated	No Deep ripping	Deep Ripped only	Deep ripped and lightly cultivated	Lime and then pasture seed mix
Bay 3 18m	Deep Ripped only	Deep ripped and lightly cultivated	No Deep ripping	Deep Ripped only	Deep ripped and lightly cultivated	Poultry manure then pasture seed mix
Bay 4 18m	Deep Ripped only	Deep ripped and lightly cultivated	No Deep ripping	Deep Ripped only	Deep ripped and lightly cultivated	Legume crop - then pasture seed mix
Bay 5 18m	Deep Ripped only	Deep ripped and lightly cultivated	No Deep ripping	Deep Ripped only	Deep ripped and lightly cultivated	Legume crop with Poultry manure then pasture seed mix