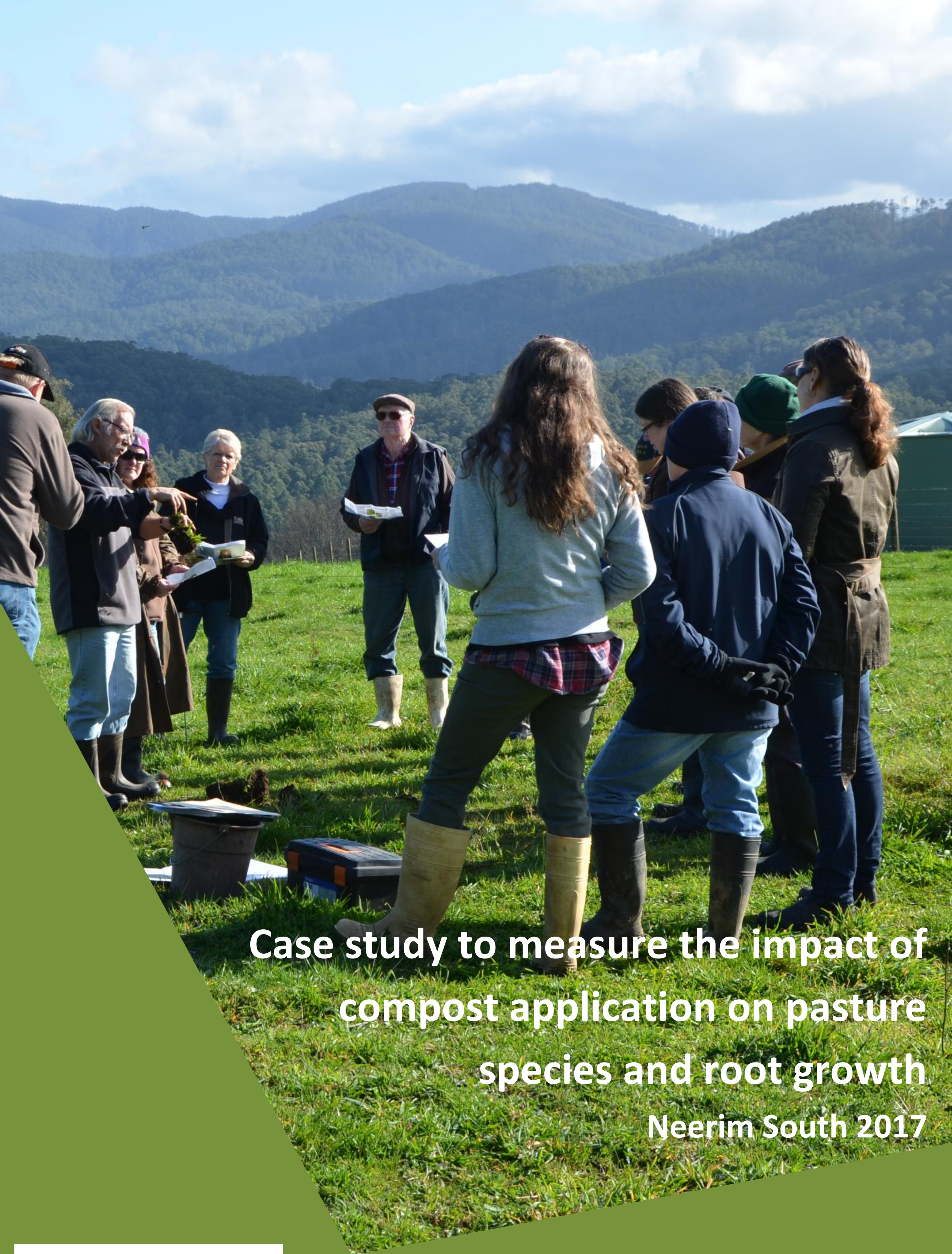


Case study to measure the impact of compost application on pasture species and root growth

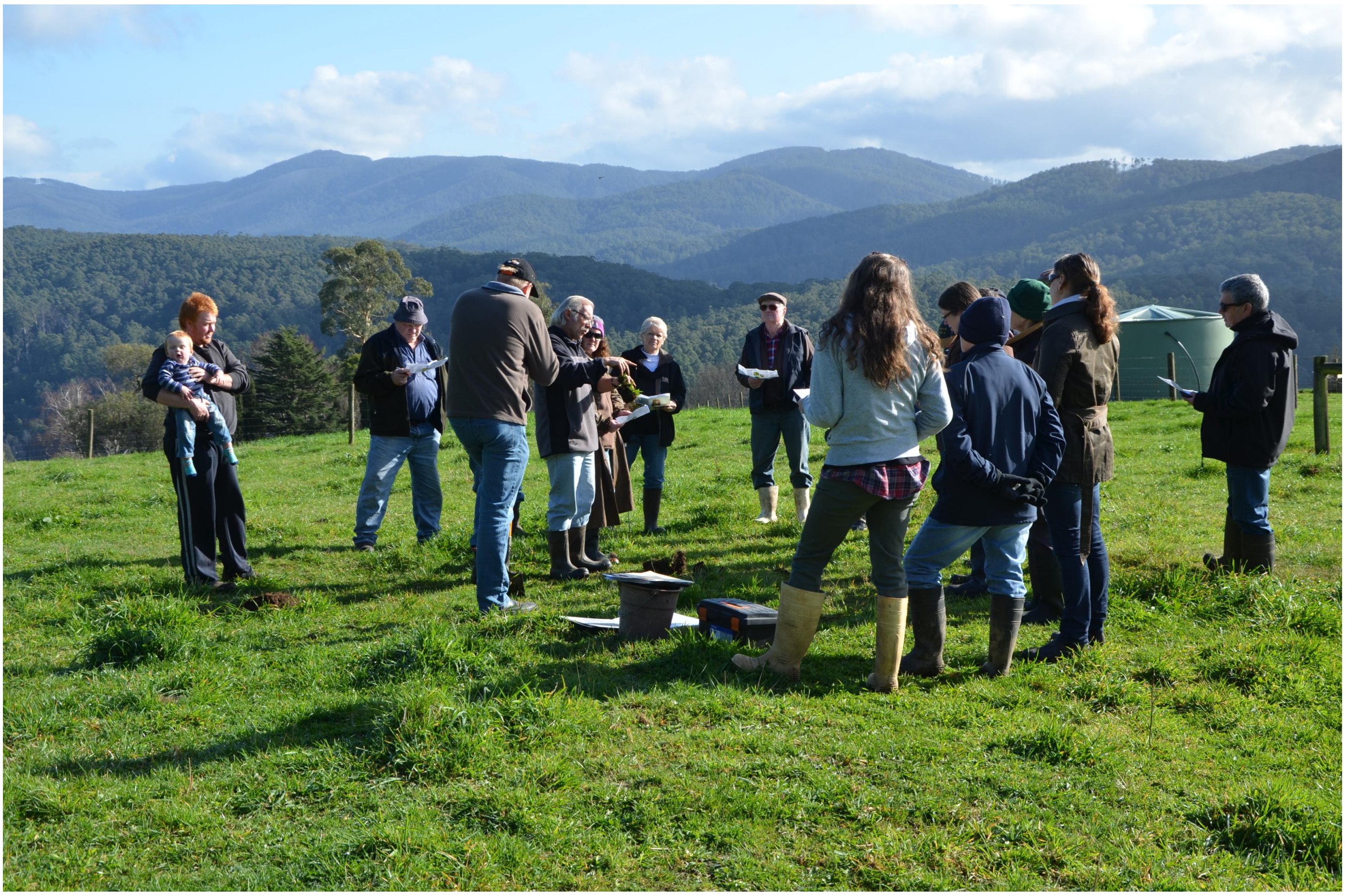
Neerim South 2017

Australian Government | National Landcare Program | Bass Coast Landcare Network | Neerim District Landcare | Mornington Peninsula Shire | wpcln Western Port Catchment Landcare Network | South Gippsland Landcare Network | Demonstrating Sustainable Farm Practices

Comparing the impact of compost application on pasture species and root growth on the Cairnsmore property Neerim South

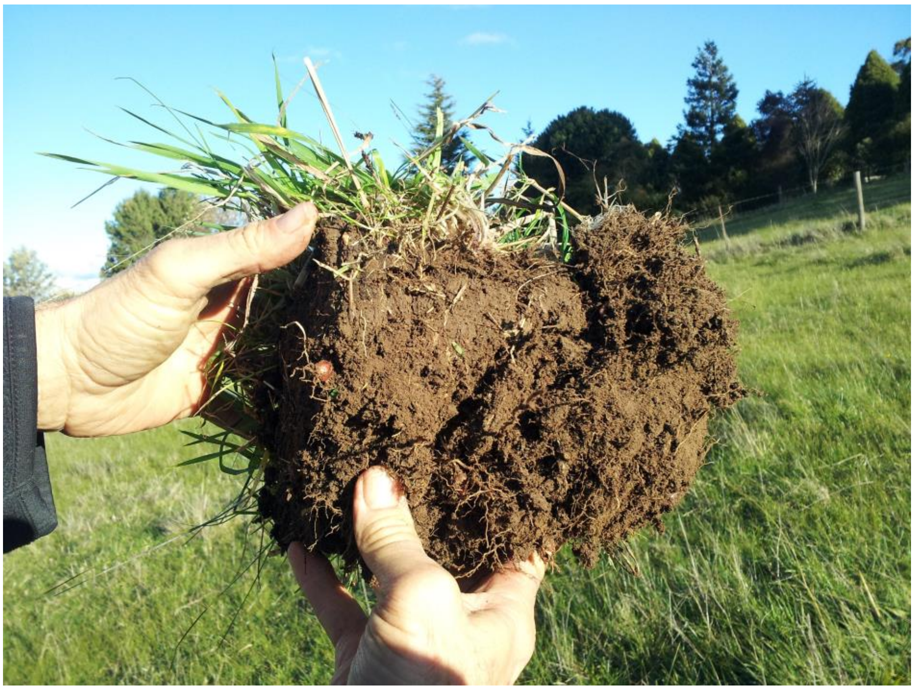
Introduction

The aim of this two year sustainable agriculture project was to increase the understanding of how compost might be used to benefit both pasture growth and species composition. The trial site is situated on a 70ha grazing farm in the Tarago catchment where steeper topography lends itself to erosion. Therefore sustainable grazing, water and soil conservation practices are important to ensure that resilient deep rooted pastures can hold the soil in place. Past research has demonstrated that compost can have beneficial effects on soils, soil health and plant productivity. (Termorshuizen et al, 2004, Hoitink, & Fahy, 1986, Compost Case Study, 2012).



Farmers attending field day at the site

The Ferrosol soils in this area are described as dark brown gradational soils generally being friable, well-structured clay loams with high levels of organic matter. Derived from Tertiary basalts, they are deeply weathered with a high ability to fix phosphorus. They are generally used for cropping and grazing.



The depth of the A-horizon is >350mm. The soil is a clay loam in texture and reddish brown in colour. The 1 hectare trial site had 2x 5t/ha applied for each of the 2 years. Each application of compost was analysed for nutrient availability**.**

Soil spit illustrating structure and root activity

Site layout - NORTH	
Paddock B - control (no compost)	Paddock A - compost applied 5t/ha annually for 2 years
SOUTH	

Demonstration site layout

Testing Protocols

Testing and monitoring criteria was based on assessment of the soil's physical characteristics, laboratory chemical analysis, biological analysis, pasture yield and feed quality.

Analysis of Results

Cairnsmore results			
	Benchmark 2014 Compost Paddock	2016 Compost Paddock	2016 Control Paddock
Ph (1:5 water)	5.8	5.75	5.54
Olsen P mg/kg	7.5	10	11
Colwell P mg/kg	21	45	43
Ammonium nitrogen mg/kg	24.1	10.9	8.7
Nitrate N mg/kg	3.1	4.3	16.9
Total Nitrogen %	0.43	0.51	0.58
Organic matter %	10.6	12	13.1
Effective CEC	12.64	12.46	13.12
Carbon %	6.04	6.86	7.48
RSAT	5.3	6.6	7.3
Solvita	5	5	3
Pasture Growth kg/DM/Ha		6,275	6,163

Soil analysis

The initial pH of 5.8 (soil water) is moderately acid which indicates reasonably high levels of hydrogen in the soil complex. The final analysis indicated a pH of 5.75 in the compost paddock and a reduced pH of 5.54 in the control.

Benchmark phosphorus levels were 7.5mg/kg (Olsen P) and 21mg/kg (Colwell P). These increased to 10mg/kg (Olsen P) and 45mg/kg (Colwell) in the compost paddock & 11mg/kg (Olsen P) and 43mg/kg (Colwell) in the control.

Total nitrogen benchmark analysis was at 0.43% and this increased over both paddocks at the end of the trial.

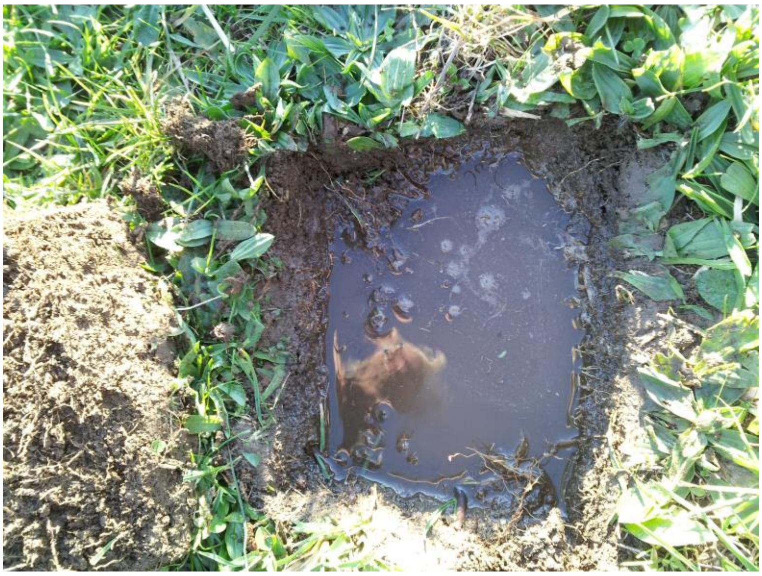
Organic matter increased over both paddocks over the 2 years.

The Cation Exchange Capacity (CEC) benchmark was 12.64% with no significant change (12.46%) at the end of the trial.

Physical observations

The Benchmark Rapid Soil Assessment Tool (RSAT) scored poorly at 5.3 (out of 9) with most prominent soil constraints being identified as a lack of soil structure, few water stable aggregates and restricted pasture root growth. These soil constraints typically support a varied and low quality pasture. At the conclusion of the trial there was no discernible change in the RSAT score between the treatments Compost – 6.6 and Control 7.3 (out of 9).

Shallow pit filled with water, slow infiltration illustrating compaction



Soil biological profile

Agpath laboratories reported in the microbiology analysis that the initial benchmark soil biology was slightly unbalanced with good bacterial activity but being low in some species of protozoa. The report also mentioned that Nematode and mycorrhiza numbers were too low to contribute to nutrient pools.

The end of trial results showed improved results with the compost paddock soil biology functioning to the extent of minimal nitrogen being required. Both bacteria and fungi were at good levels with sufficient protozoa to enable cycling of organic matter. The laboratory reported that the control paddock also improved from 2014, but not to the same extent as the compost paddock.

Solvita soil health test (CO_2 respiration)

A benchmark soil sample taken from the compost paddock indicated a 5 (scale 1-5) which suggests high biological activity in the soil. The test taken at the end of the trial also indicated a 5 (scale 1-5 which suggests high biological activity in the soil. However, the control indicated a 3 (scale 1-5) which suggests only medium biological activity in the soil. This may indicate the compost is stimulating biological activity and is supported by the comments from the Agpath biological analysis.

Observations of pasture yield

Pasture yield was measured from Oct 2014 to July 2016 (a period of 21 months). An electronic 'GM Pro' Pasture Meter was used to measure the pasture. The pasture was measured prior to the cattle entering the paddock for grazing. There was a slight increase in the available pasture yield in the compost applied paddock (6,275kg/ha) over the control paddock (6,163kg/ha). Major constraints to pasture production appear to be the moderately acidic soil, low nitrate nitrogen and phosphorus.

Feed analysis observations

Pasture samples were analysed by FeedTest each July. There was no difference in the nutritional analysis of the pasture between the treatments.

Comments on the use of compost

Compost has been used widely in trials across the Gippsland region. The compost analysis from the two deliveries varied significantly. This is not uncommon as ingredients can change between batches, and the composting process itself can be variable according to production conditions at the time.

The results of the 2 batches of compost are displayed in the table below.

Compost analysis		
	2014	**2016**
Nitrogen %	1.64	1.39
Phosphorus %	0.29	0.27
Potassium %	1.31	0.99
Sulphur %	0.86	0.22
Carbon %	29.0	18.3
Calcium %	2.02	1.78
Magnesium %	0.69	0.57
Sodium %	0.26	0.23
pH (1:5 water)	8	7.7
Carbon: Nitrogen ratio (desirable 14:1)	17.7:1	13.2:1

Phosphorus levels in both batches of compost were low (but typical of most green waste composts). The wide C:N ratio of 17.7:1 means that only about 5% of the nitrogen will initially be mineralised. With an analysis of 1.64% nitrogen, only 16kg of nitrogen is contained per tonne of compost, but with only 5% being mineralised there will be less than 1kg of nitrogen available to the pasture per tonne of compost. The C:N ratio of the second batch analysed much lower with an improved C:N (13.2:1) ratio meaning about 1.39% nitrogen or 13.9kg is contained per tonne of compost, with about 15.4% of this being mineralised after application.

As compost continues to decompose after application, there is gradual release of plant nutrients. In a well-made compost with a C:N ratio of 12-14:1 about 14% of the nitrogen may be mineralised within 12 months. The balance is released over time. Potassium is more readily available than nitrogen while 30-40% of phosphorus is available within two years of application. (Compost for Soils, 2011).

Financial analysis

Cost

The cost of supply, delivery and spreading of the compost with two applications @ 5t/Ha (calculated at $10m^3$/ha) @ $60m³ (spread annually) = 2 x $600 = $1,200

The financial analysis for this trial clearly indicates in real terms that there was no increase in pasture production. There is however a benefit from the addition of mineral elements contained in the compost.

Nutrient Value of applied compost

Nutrient additions in compost based on March 2010 fertiliser prices.

$ Value of Nutrients in 1t of Compost						
Nutrient	**kg/tonne compost (Yr 1)**	**kg/tonne compost (Yr 2)**	**$/kg ***	**$/tonne compost (Yr 1)**	**$/tonne compost (Yr 2)**	**Total $/tonne compost 2 years)**
Nitrogen	16.4	13.9	$ 1.27	$ 20.83	$ 17.65	$ 38.48
Phosphorus	2.9	2.7	$ 4.40	$ 12.76	$ 11.88	$ 24.64
Potassium	13.1	9.9	$ 1.68	$ 22.01	$ 16.63	$ 38.64
Calcium	20.2	17.8	$ 0.50	$ 10.10	$ 8.90	$ 19.00
Sulphur	8.6	2.2	$ 0.70	$ 6.02	$ 1.54	$ 7.56
			TOTAL	**$ 71.72**	**$ 56.61**	**$ 128.32**

* based on March 2010 fertiliser prices, calculating the $/tonne by the % nutrient/tonne.

Value of nutrients spread at 5t/ha annually over 2 years = $64.16 x 10t = $641.60

Source: www.compostforsoils.com.au/images/pdf/cropping/pasture_cropping_web.pdf

Intangible benefits

There may be ongoing benefits that have accrued due to the positive increases in organic matter and organic carbon, such as an increased water holding capacity of the soil.

Carbon applied in the compost							
Carbon	kg/t compost (Yr 1)	Rate	Total Carbon applied year 1	kg/t compost (Yr 2)	Rate	Total Carbon applied year 2	Total Carbon applied both years
	295.8	5t/Ha	1,475kg/Ha	185.6	5t/Ha	925kg/Ha	2,400kg/Ha

Summary

The benchmark soil assessment, including the physical, biological and chemical parameters indicated that the soil base had constraints that were reflected in the production of poor pasture species and yield.

Soil chemistry indicated low pH, low nitrogen, and phosphorus with levels seen as potential restraints to increased production and the attainment of improved pasture.

The initial benchmark of nitrate nitrogen at 3.1mg/kg (desirable 13mg/kg) is indicative of a soil where organic matter is not cycling as efficiently as it could. Low pH and compaction can negatively affect nutrient cycling.

Although no changes were observed in pasture composition and root architecture the soil chemistry indicates positive changes in Olsen P, Colwell P and organic matter/organic carbon in both the compost and control paddocks. Seasonal influences cannot be ruled out in the improvement in these results due to the similar increases in both paddocks.

Previous reports on the application of compost to pasture (Compost Case Study, 2012, Compost for soils, 2011) have demonstrated the potential benefits including the reduction in the amount of synthetic fertilisers applied. It is possible that over the next few years mineralisation from the compost could positively affect soil physical, chemical and biological properties thereby having a positive effect on pasture composition. The short nature of the trial does not necessarily allow the full benefits from the compost to be seen but it is also evident that various soil chemistry deficiencies urgently need addressing.

Key learnings from demonstration

- Benchmark soil analysis indicated deficiencies in nitrogen, phosphorus and soil pH. These deficiencies should have been addressed prior to the demonstration beginning
- Low nitrate nitrogen levels in the benchmark soil analysis indicate that the high levels of organic matter were not cycling adequately
- The length of the demonstration is probably not sufficient to provide information that may indicate positive changes
- There was no change in pasture yield or composition over the length of the demonstration

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