Healthy Soils Healthy Foods

Summary created December 2017

Location / address:	**Broadford, Victoria**
Organisation(s):	South West Goulburn Landcare Network and Soil Management Systems
Contact person:	Brenton Byerlee and Paul Fleming
Fund source:	National Landcare Program - GB CMA SoilCare Small Project Grants 2012-15 and Community Landcare Grants (Australian Government).
Year/s of trial:	2012-2015
Objectives of the demonstration	• To evaluate the effectiveness of soil treatments designed to increase microbial activity. • To increase the release of soil nutrients and reduce reliance of external inputs. • To increase pasture production under a rotational grazing system.
Basis of trial	The project will concentrate on building resilience by improving soil structure, encouraging more effective aggregation of soil particles, allowing better flow of water and air through the soil, creating a better habitat for soil micro and macro biota. This will lead to improved plant access to soil stores of nutrients and achieve deeper root growth to increase deep cycling of nutrients. The project anticipates a change in farming practices which will increase soil carbon and reduce nitrogen loss while simultaneously increasing water holding capacity and nutrient release. It will bring together farmers managing similar soils to achieve more productive enterprises. As caretakers of the land, farmers involved in this project want to leave their farms in a better state than when they first arrived. The challenge is to do this in a cost-effective and sustainable way. This project involves three demonstration trial sites, in the South West Goulburn Landcare Network area, trialling a range of soil treatments designed to increase microbial activity. Under the guidance of Brenton Byerlee, of Soil Management Systems, host farmers will be making strategic applications of gypsum and foliar sprays to unlock available nutrients already within the soil and to encourage microbial soil activity.Over the three-year period (2012-2015) the project monitored: • Nutrient levels within the soil • Nutrient levels within the plant tissue • Pasture growth rates • Stocking rates • Animal productivity measured in kilograms of beef per hectare. Site 1 (Healey's): • Paul Flemming's home property south of Broadford. • Consists of 150 hectares of undulating ironstone country. • The average rainfall is 700mm. • The pasture is a base of Australian Phalaris, native grasses and self-sown annual and perennial ryegrass. • The 150ha is divided into 25 cells. • Currently running 71 autumn calving cows and calves (March) and 45 joined heifers. • The calves are weaned in January and sold in February. • The aim is to maintain the stocking rate of 100 1st and 2nd calving cows but to no longer rely on supplementary feed.

	Site 2 (Zwar's): • Paul Flemming's leased property north of Broadford. • Consists of 64 hectares of black volcanic soil. Most of the property is flat. • The average rainfall is 700mm • The pasture is a base of Australian Phalaris, native grasses and self-sown annual and perennial ryegrass. • The 64 ha is divided into 23 cells. • Currently run 43 autumn calving cows and calves (March). • The calves are weaned in January and sold in February. • The aim is to lift the stocking rate to 48 cows and carry them with ease.
What was achieved /soil treatments	Site 1 (Healey's) has sandy loam soils , while Site 2 (Zwars) is a heavier clay loam that wets up more slowly than the lighter soils but usually holds on longer at the end of the season. Sites 1 (Healey's) and 2 (Zwars) in the trial utilize a grazing management system known as cell grazing. This has greatly assisted in the collection of valuable grazing data, as livestock are rotated through 23-24 cells (small paddocks) based on feed availability and pasture recovery. Cell grazing improves farm productivity by maximizing pasture growth, maintaining pasture quality and regulating the even distribution of animal nutrients across the cells. These properties currently produce 236kg beef/ha. The regime of treatments applied to the trial sites between 2013 and 2015 are presented in the tale below. Treatments applied Lime at 3t/ha was applied to all cells in 2011 In 2012 treatments to cells 1, 2, 8, 9, 10, 11, 16, 17, 22, 23 were

2012	Treatment Costs	Cost/ha
Gypsum 2t/ha	$49/t + $17/t	$132
Nutri-soil 5ltr/ha	$25/ha + $10/ha	$35
SMS TE Mix 2ltr/ha (Mn 4% ,Zn3%, Cu2%, Bo 0.5%, Mo 0.1% Co 0.1%)	$25/ha	$12
Total Cost		$4,868.80

Healey's - Gypsum @ 1 tonne /ha
- Nutrisol @ 5 litres/ha
- SMS TE Mix @ 2ltr/ha

Healy's August 17—2.5 tonnes/ha Gypsum, August 21---90kg/ha Urea
Healy's 19/22 August 17 - 2.5 tonnes/ha Gypsum, August 21---90kg/ha Urea
Healy's 2 August 17 - 2.5 tonnes/ha Gypsum, August 21---90kg/ha Urea

Measurements When/how/method	A baseline of soil conditions was established, using soil tests, biological activity measurement and current pasture growth rates. Recommended soil treatments were applied. Changes in nutrient levels in the soil and plant tissue, pasture growth rates, stocking rates and animal production in kilograms per hectare were monitored.

Results	

Changes in soil health

Include a paragraph describing the changes in soil health as a result of the treatments referring to the baseline soil and plant tissue test results attached.

Changes in production

Table 1 and 2 below describe the changes in animal growth rate during winter and spring 2015. Growth rate calculations were made from the average of visual pasture measurements and stock during the period.

Table 1: Winter production benefits - change in animal growth rate (average kg/ha/day) over winter period between treated and control areas for Site 1 (Healey's) and Site 2 (Zwars).

		Winter Average kg/ha/day			
		Treated	Control	Difference	
SITE 1 - HEALEY'S	**2 & 4**	11.275	5	6.275	126%
	22 & 19	11.25	4.2	7.05	168%
SITE 2 - ZWARS	**1 & 2**	9.25	6.2	3.05	49%
	22 & 23	9.25	7.2	2.05	28%

There was a significant drop in winter production from the previous year most likely aligned to extremely dry conditions in the 2015 autumn and winter, compared with near perfect autumn and winter in 2014. Treated cells produced 40% more dry matter than untreated cells.

Table 2: Spring production benefits - change in growth rate (average kg/ha/day) over spring period between treated and control areas.

		Spring Average kg/ha/day			
		Treated	Control	Difference	
SITE 1 - HEALEY'S	**2 ****	25	11	14	127%
	22 & 19 **	23	5.1	18	353%
SITE 2 - ZWARS	**1 & 2**	10.3	7	3.3	47%
	22 & 23	14	11	3	27%

** Healy's cells 19, 22 were shut for silage on July 8, Cell 2 shut for silage on July 29.

Changes in profitability

The costs of the treatments are calculated using a discount factor of 5%. In short a given dollar value in the future is discounted back to todays value by discounting it according to how far away in time the return (or the cost) will be realised. The sum of these discounted costs and returns is referred to as the Net Present Value or NPV.

The NPV;s for each treatment are given in Table 3 below. These treatments were applied between 2013 and 2015. It is not shown here but an additional cost of $120 every four years was included. The values in the table are calculated on the NPV over 20 years.

Table 3: Net Present Value of treatment costs including and excluding the lime applied

SITE	**CELL**			**NPV ($/HA)**
		5.0% discount rate, Excl lime cost		
		Period of discounting		
		20 years	10 Years	5 years
SITE 1 - HEALEY'S	2 & 4	$663.19	$573.65	$479.62

	22 & 19	$939.94	$850.40	$756.37
SITE 2 - ZWARS	1 & 2	$929.51	$839.96	$745.94
	22 & 23	$929.51	$839.96	$745.94

The discounted costs decrease as the period over which they are calculated decreases simply because the up-front costs are all discounted the same and the ongoing costs are less for a five year period than a 20 year period.

When it comes to getting a return on the costs however it is easier to break even or make a profit on if the increased returns can be realised for 20 years rather than five years, this can be seen in Table 4 below.

Table 4 Break even values ($/ha) to match discounted costs of treatments

SITE	**CELL**	**BREAK EVEN RETURN ($/HA)**		
		5.0% discount rate, Excl lime cost		
		Period of discounting		
		20 years	10 Years	5 years
SITE 1 - HEALEY'S	2 & 4	$57.03	$76.14	$ 104.18
	22 & 19	$80.83	$ 112.87	$ 164.29
SITE 2 - ZWARS	1 & 2	$79.93	$ 111.49	$ 162.03
	22 & 23	$79.93	$ 111.49	$ 162.03

If increased returns were experienced over five years only then the marginal increase in returns in Healeys 2 & 4 for example would have to equal $104.18/ha. If the increased returns were experienced over 20 years however the marginal increase would only need to be $57.03/ha, nearly half. Clearly this would make a big difference to the financial viability of the alternative management regime.

So in the case of Site 1 (Healey's) and Site 2 (Zwars), youwould only need to return an additional $4,860 per year if the benefits were only to last for five years, $3,400 if the benefit endures for 10years and $2,500 if it lasts 20 years. All assuming it was standard practice to apply lime anyway.

Winter production benefits (inc stock no. Potential) Average kg/ha/day		
Treated	**Control**	**Difference**
11.275	5	6.275
11.25	4.2	7.05
9.25	6.2	3.05
9.25	7.2	2.05

Attachment 1 - Summary of soil test results

Zwar

Deficient	Slightly Low	Excess

						ANIONS							
SAMPLE ID		**LAB #**	TEC	ORGANIC MATTER	PH H2O	N	S	TOTAL P	P OLSEN	DGT Phosph	Phosph Bray 2	P DEFICIT	P RECOVERY
				%		kg/ha	ppm	ppm	ppm	ppm	kg/ha	kg/ha	%
DESIRED			12-25	4-6	6-6.5				18-28		126		100
4577 Zwar 1 & 2	Treated	D105	24.68	6.7	5.68	109	41	1041	5	33	69	57	46
4604 Zwar 6	Un-treated	D102	21.63	6.5	5.95	108	25	959	3	29	74	52	36.67
4605 Zwar 22 & 23	Treated	D103	35.01	6.8	5.44	109	44	581	5	I/S	45	113	40
4606 Zwar 20 & 21	Un-treated	D104	38.34	8.4	5.65	117	22	745	6	I/S	57	101	42

			CATIONS				TRACE ELEMENTS						
SAMPLE ID		**LAB #**	Ca	Mg	K	Na	Co	B	Fe	Mn	Cu	Zn	Mo
			kg/ha	kg/ha	kg/ha	kg/ha	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DESIRED							> 1.5	> 0.8	100-400	80-140	> 2	> 8	0.8 - 1.2
4577 Zwar 1 & 2	Treated	D105	4985	1504	319	164	1.75	0.46	178.1	75.91	1.47	2.85	1.79
4604 Zwar 6	Untreated	D102	4831	1620	287	103	1.81	0.38	227	72.7	1.28	2.22	1.62
4605 Zwar 22 & 23	Treated	D103	5746	2145	247	138	3.34	0.41	617.3	73.04	1.21	1.82	1.46
4606 Zwar 20 & 21	Untreated	D104	6835	2714	235	130	3.1	0.45	560.7	91.66	1.24	2.7	1.4

					BASE SATURATION %							
SAMPLE ID		**LAB #**	CHLORIDES	SALINITY	Ca:Mg RATIO	Ca	Mg	K	Na	Other Bases	Exch Hydrogen	S
			mg/kg	EC 1:5		%	%	%	%	%	%H	mg/kg
DESIRED			< 200	< 2	5.67	68	12	3.1	1.5	3.4	12	8
4577 Zwar 1 & 2	Treated	D105	30	0.08	2.01	44.9	22.3	1.5	1.3	6	24	6
4604 Zwar 6	Untreated	D102	10	0.04	1.81	49.6	27.4	1.5	0.9	5.6	15	
4605 Zwar 22 & 23	Treated	D103	50	0.09	1.62	36.5	22.5	0.8	0.8	6.4	33	11
4606 Zwar 20 & 21	Untreated	D104	20	0.05	1.53	39.6	25.9	0.7	0.7	6.1	27	

Attachment 2 - Summary of plant tissue test results

PLANT ANALYSIS SUMMARY - Zwar Sept 2012

Deficient	Slightly Low	Excess

Sample ID			Crop	N %	Nitrate	Crude protein %	S %	P %	K %	Mg %	Ca %
			Pasture	**4.8**	n/a	**29.7**	**0.38**	**0.42**	**3.5**	**0.24**	**0.9**
2365 Zwar 1 & 2	Treated	PT023	Pasture	2.7	0.01	16.9	0.37	0.36	2.02	0.27	0.58
2366 Zwar 6	Untreated	PT024	Pasture	2.96	0.01	18.5	0.23	0.29	1.64	0.26	0.5
2364 Zwar 22 & 23	Treated	PT022	Pasture	3.11	0.01	19.4	0.35	0.34	1.98	0.25	0.64
2370 Zwar 20 & 21	Untreated	PT010	Pasture	3.86	0.01	24.1	0.21	0.39	2.18	0.24	0.48

Example ID			Crop	Na %	Cl %	Fe ppm	Al ppm	Mn ppm	B ppm	Cu ppm	Zn ppm
			Pasture	**0.2**	**1.3**	**213**	**43.8**	**123**	**14.3**	**11.3**	**45**
2365 Zwar 1 & 2	Treated	PT023	Pasture	0.12	0.7	957	586	121.5	6.6	7	26.9
2366 Zwar 6	Un-treated	PT024	Pasture	0.21	0.7	441	280	140.9	6	5.8	21.1
2364 Zwar 22 & 23	Treated	PT022	Pasture	0.18	0.78	740	548	232.7	6.8	6	24.9
2370 Zwar 20 & 21	Un-treated	PT010	Pasture	0.16	1.24	456	279	156.9	4.6	5.9	17.3

Example ID			Crop	Co ppm	Mo ppm	Ca/P Ratio Index	Cation Index	Cation: Anion Index	Grass Tetany Index
			Pasture	**0.1**	**1.6**	**n/a**	n/a	**n/a**	**n/a**
2365 Zwar 1 & 2	Treated	PT023	Pasture	0.78	0.5	1.6	0.4	140	1
2366 Zwar 6	Untreated	PT024	Pasture	0.34	0.4	1.7	0.4	170	0.9
2364 Zwar 22 & 23	Treated	PT022	Pasture	1.22	0.2	1.9	0.4	149	1
2370 Zwar 20 & 21	Untreated	PT010	Pasture	0.61	0.5	1.2	0.3	147	1.3