Pasture Challenge

Farmer-designed trials to overcome soil constraints

More than 50 livestock producers are keeping a close eye on in South West NRM's 'Pasture Challenge' on a property in Yoongarillup, near Busselton.

The farmers were challenged to overcome soil constraints and lift pasture productivity without breaking the bank. By testing a range of soil properties prior to commencement, the farmers identified and prioritised soil-based limitations that can be addressed to lift pasture production.

The farmers organised themselves into four groups and developed agronomic packages to overcome soil constraints at the site.

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The Challenge Site

The Challenge site is on the Abba plain south of Busselton and has a less productive sandy ridge that runs into more fertile loamy sand flat.

Initial site assessment including soil and tissue tests, root inspection and compaction assessment identified that:

- The pasture sward of consisted barley grass, capeweed, clover and some ryegrass.
- The site is severely compacted below 10cm;
- The clover appears to be nodulating poorly;
- Clover roots tend to be severely diseased;
- Soil carbon levels are 3-4% in the top 10cm and below 1% from 10-20cm;
- Soil pH in CaCl2 is around 5 in the top 10cm and 4.2 from 10-20cm on the ridge;
- Soil test results showed sulphur is the primary limiting nutrient on the ridge, whereas potassium is the limiting on the flats. Both decrease with depth.
- Tissue tests on ryegrass and clover identified deficiencies in copper (ryegrass on flats only) and selenium.

Each of the four groups of farmers developed an agronomic package according to what they thought needed to be done. The package was applied to three randomised strip plots (50 m x 3 m wide) that run down a gentle slope onto the flat. A Nil treatment was also included.

The four groups are:

- The Soil pH Group;
- The Plant Biology Group;
- The Rippers;
- The Meat & Potatoes Group.

The tables below show how each treatment has been managed by each group up to 30 August, 2023, with their management decisions being implemented by agronomist Graham Mussell.

Species sown included: Williams oats; Harpoon barley; Astound annual (tetraploid) ryegrass; Kidman perennial ryegrass; Taipan Balansa clover; Shaftal Persian clover; Pillar forage rape; and Sodbuster tillage radish.

The cover crop mix consisted of peas, ryecorn, oats, ryegrass, balansa, crimson clover, chicory, plantain.

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Date	Soil pH Group	$/ha
15-Apr	Limed 5t/ha	$212
16-Apr	Cultivated	$20
17-Apr	Dragged & rolled	$15
4-May	Sprayed 1.5 L glyphosate + 100 mls bifenthrin	$15
5-May	Sown: 10 kg Willams, 10 kg Harpoon, 10 kg Astound, 10 kg Kidman, 3 kg Pillar, 1.5 kg Tiapan, 1.5 kg Shaftal	$212
21-Jun	Graze 600 kg/ha DM	
26-Jun	Reset to 6 cm with mower	
28-Jun	75kg/ha SoA; 3kg/ha ZnSO4, 2kg/ha CuSO4, 4kg/ha MnSO4 50kg/ha MOP on flats.	$71.5/$131.50
3-5 Aug	Graze 1300kg/ha DM	
7-Aug	Reset to 6 cm with mower	
30-Aug	Topdress 55kg/ha urea (25kgN)	$44
	Cost per hectare to date (higher cost on flat):	**$590/$651**

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Date	Plant Biology	$/ha
15-Apr	Limed 2.5t/ha	$106
17-Apr	Sown: 15 kg humates, 25 kg cover crop blend, 2 kg pillar, 2 kg sodbuster - rolled	$220
20-Apr	Sprayed 450 mls/ha glyphosate (500 g/L)	$12
1-May	Sprayed 100 mls/ha bifenthrin RLEM ctl	$11
12-May	Top-dressed 50 kg/ha urea, 20/ha kg kieserite, 0.6 kg/ha Selcote	$66
21-Jun	Graze 1100 kg/ha DM	
26-Jun	Reset to 6 cm with mower	
20-Jul	Sprayed 40 L/ha Biosoil Bio+Min	$210
3-5 Aug	Graze 900kg/ha DM	
7-Aug	Reset to 6 cm with mower	
21-Aug	Spray 250g/ha Boron (0.5kgB)	$11
30-Aug	Topdress 66kg/ha super, 43kg/ha urea, 48kg/ha Sulphate of potash	$156
	Cost per hectare to date:	**$792**

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Date	Rippers	$/ha
15-Apr	Limed 2.5 t/ha	$106
16-Apr	Cultivated	$20
17-Apr	Dragged & rolled	$15
4-May	Sprayed 1.5 L glyphosate + 100 mls bifenthrin	$15
5-May	Sown: 30 kg Astound, 2 kg Sodbuster, 2 kg Taipan, 2 kg Shaftal	$180
15-Jun	Ripped to 400 mm depth	$60
21-Jun	Graze 300 kg/ha DM	
26-Jun	Reset to 6 cm with mower	
28-Jun	50kg/ha urea (23kgN); 180kg/ha Super Potash 31 flats (12kgP, 22K, 14kgS)	$35/$188
3-5 Aug	Graze 1163kg/ha DM	
7-Aug	Reset to 6 cm with mower	
30-Aug	Slope 60kg/ha Super Potash 3:1; Flat 180kg/ha Super Potash 3:1; 100kg/ha urea on both	$121/$223
	Cost per hectare to date (higher cost on flat):	**$554/$807**

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Date	Meat & Potatoes (M+T)	$/ha
16-Apr	Cultivated	$20
17-Apr	Dragged & rolled	$15
4-May	Sprayed 1.5 L glyphosate + 100 mls bifenthrin	$15
5-May	25 kg Astound, 2.5 kg Taipan, 2.5 kg Shaftal (treated)	$147
10-May	Spray 3 kg/ha CuSO4 (0.75kgCu) on soil	$29
21-Jun	Graze 280 kg/ha DM	
26-Jun	Reset to 6 cm with mower	
28-Jun	90kg/ha NS31; 750 ml/ha Tigrex + 25g Broadstrike	$91.50
3-5 Aug	Graze 1163kg/ha DM	
7-Aug	Reset to 6 cm with mower	
7-Aug	120kg/ha NKS32 (30kgN, 15kgK, 6.6S)	$108
30-Aug	180kg/ha grazeburst (45kgN, 7kgP, 15kgK, 11kgS)	$180
	Cost per hectare to date:	**$606**

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Results to September 2023

Throughout 2023, treatments were assessed using a range of soil tests, and the pasture was cut to measure yield and pasture quality.

All treatments still had varying levels of clover root disease, which were confirmed as a complex of diseases including *Rhizoctonia, Pythium, Aphanomyces* and *Phytophthora*.

However, the pH plot, appeared to be least affected by disease.

Digging up clover roots to investigate clover root colour was an effective way to assess the presence of root rot because the colour of roots was associated with the presence of diseases.

Clover root rot expert Professor Martin Barbetti from UWA assessed images of diseased roots and made the following conclusion:

"If you have any productivity in the clover that will be a miracle for the first month or 2 of the season but now onwards (late August) surviving plants do have a tendency to recover as weather warms."

Clover root nodulation was typically poor to moderate with some minor variation between treatments. However, the Nil treatment a distant last!

Compaction tests showed that ripping in June removed severe compaction, whereas it remained in all other treatments.

Tissue tests were taken in June to understand the effect of incorporating 5 tonnes of lime per hectare on micronutrient availability. Lime can reduce availability of copper, zinc and manganese, but increase molybdenum.

The effect of the lime appeared greatest on manganese and molybdenum, which is commonly observed. Manganese deficiency can be corrected with a foliar spray. High molybdenum increases risk of inducing copper deficiency if copper is low. While the result for copper was adequate, copper sulphate was sprayed on pH plots to reduce risk.

Pasture Yield and Quality

Pasture yield and quality was measured in June, August, September and October.

As of 22 September, the pH and Biology plots had produced the most dry matter followed by the Ripper treatment.

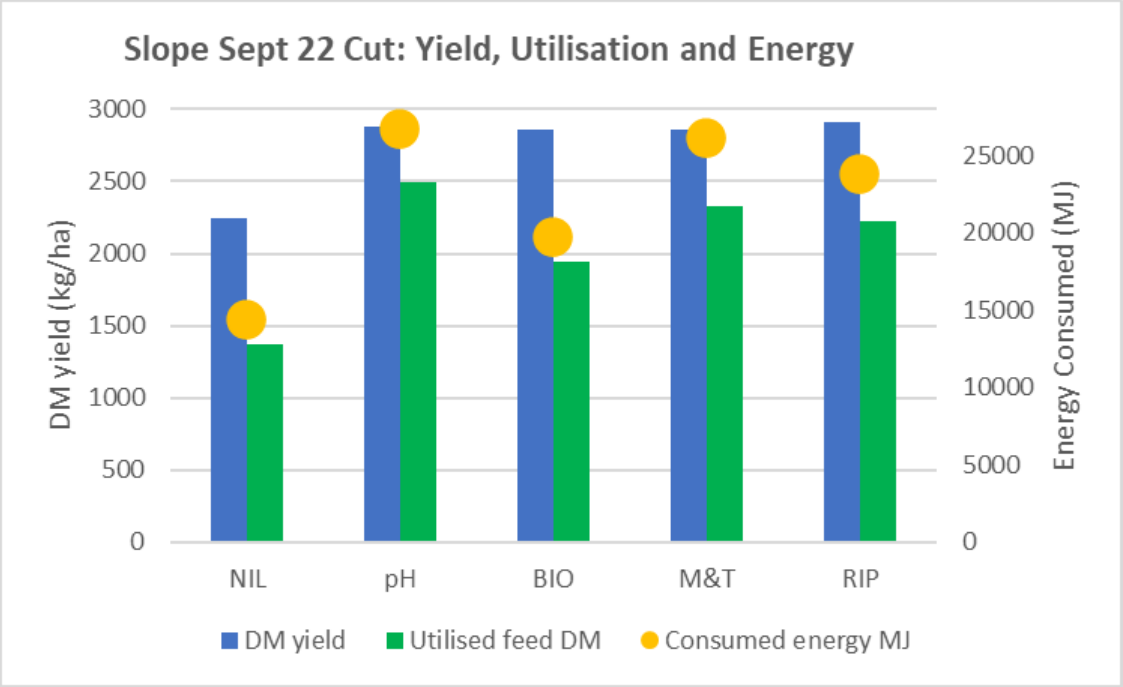
Feed tests up until September have shown that the Meat and Potatoes treatment has contained the most energy.

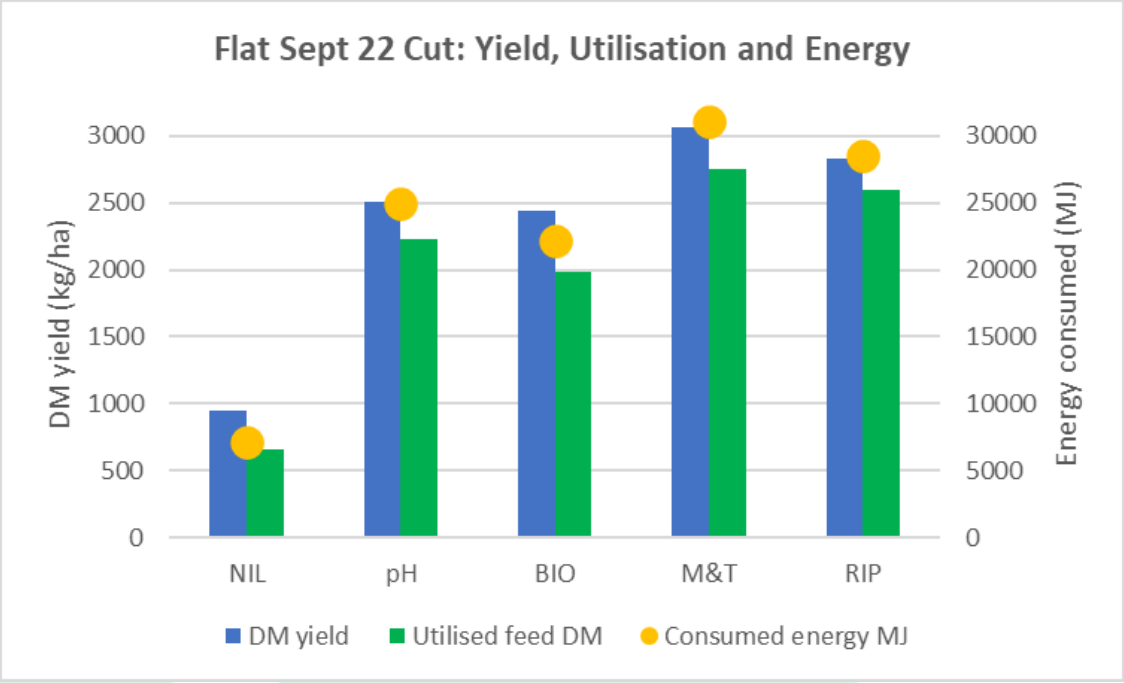
The graphs below show pasture yield and quality for the September cut only. The amount utilised by animals (consumed energy) was also measured.

A final cut was taken for yield and quality in October. These results will be released at the final event on February 14, 2024 in Busselton.

Sample ID	Neutral Detergent Fibre (NDF) - NIR	Acid Detergent Fibre (ADF) - NIR	Crude Protein (CP) - NIR	Inorganic Ash - NIR	Organic Matter (OM) - NIR	Dry Matter Digestibility (DMD) - NIR	DOMD - NIR	Calculation of Metabolisable Energy (ME) - NIR	Water Soluble Carbohydrates (WSC) - NIR
Slope M+T	50.2	25.1	17.7	10.1	89.9	74.1	69.7	11.2	10.7
Slope RIP	51.8	26.4	18.2	11.2	88.8	71.3	67.6	10.7	8.3
Slope pH	51.5	26.6	15.2	10.3	89.7	71.3	67.3	10.7	10.3
Slope NIL	47.9	26.3	14.1	11.2	88.8	69.6	66.3	10.5	11.2
Slope BIO	55.3	28.8	13.6	9.7	90.3	67.8	64.8	10.1	10.1
Flat M+T	49.0	24.7	17.4	11.4	88.6	75.1	70.3	11.3	12.3
Flat pH	48.6	24.3	15.9	11.9	88.1	74.0	70.1	11.2	13.5
Flat BIO	48.6	24.2	14.7	11.0	89.0	73.3	70.1	11.2	14.2
Flat RIP	50.1	25.1	17.7	11.7	88.3	72.2	68.9	11.0	10.3
Flat NIL	50.5	23.1	13.0	9.3	90.7	70.5	68.6	10.9	12.0

Table: *Feed test results for September. Tests were conducted with each yield cut. Energy is considered the best indicator of quality.*





Figures: *Yield in dry matter per hectare measured In September only on (top) the slope and (bottom) the flat. Residuals were remeasured after grazing to calculate what feed was utilised, and this was combined with metabolisable energy content to calculate consumed energy.*

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Tissue tests in September found:

- Most of the macronutrients (N,P,K,S) were within the target ranges with the odd exception.
- Selenium was low across the board which is seen in most tissue test results. Se was no higher in the Biology treatment than other treatments despite a topdress 600g/ha of Selcoat, highlighting the rapid uptake and/or leachability of sodium selenate.
- Nearly all of the cobalt levels in the clover samples met or exceeded the recommended target values for animal health. However, none of the ryegrass samples achieved this.

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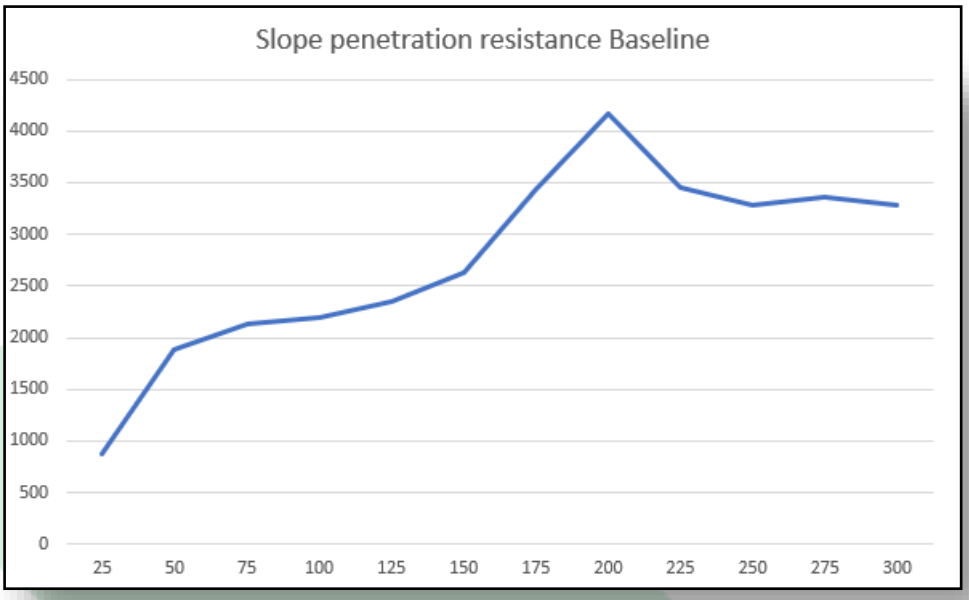
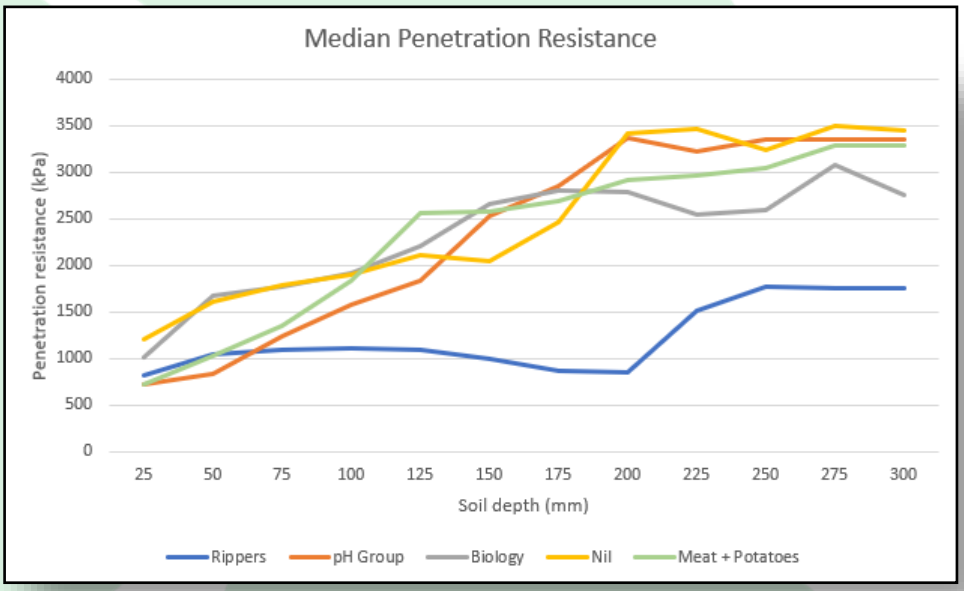
Penetration Resistance testing (September)

Penetration resistance has been related to crop root growth in wet soils close to the drained upper limit. In general crop root growth starts to be restricted when the penetration resistance exceeds 1.5 MPa and is severely restricted at 2.5 MPa or more. Resistance was measured with a digital penetrometer that records penetration resistance in 25 mm increments.





Figures: *(Top) penetration resistance measured on the slope in September 2022, and (bottom) penetration resistance measured for each treatment on the slope in September 2023.*

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Soil testing and interpretation.

Final soil tests were collected at the site in early December 2023 by agronomist Graham Mussell and South West NRM Sustainable Agriculture Manager Peter Clifton. These were taken at two depths, 0-10 cm and 10-20 cm for each treatment with samples separated between the slope and flat.

Soil sampling procedures followed the Fertcare Soil Sampling Guide, with 10 cores taken in each replicate plot and bulked together into a single sample for each treatment.

Interpretation of results will be done through the Nutrient Calculator for High Rainfall Pastures in WA, developed by DPIRD.

Results will be presented at the final event in Busselton on February 14. 2024.

Images: *(Left) Extracting a dig stick hammered 20 cm into the soil, and (right) removing the bottom 10-20 cm core for the subsoil sample. Top soil samples were collected at the same intensity but with a drill.*

Final Results (February)

Final results will be released at a field day in February, 2024. To keep in touch, register for updates by sending contact details to Peter Clifton on 0409 680 900, or pclifton@southwestnrm.org.au with "Pasture Challenge" in the subject line.

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