Farmer-designed trial to overcome soil constraints

The Pasture Challenge was designed to engage farmers in soil testing, soil test interpretation and improving soil health.

A "problem paddock" was sampled with a range of soil-related tests in 2022 and results presented to farmers in February 2023. Farmers arranged themselves into groups based on what they believed to be the major soil constraint, and formulated an agronomic package aimed at addressing soil constraints and improving productivity without breaking the bank.

The groups returned several times during 2023 to assess progress and review their plans.

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 $CaCl_2$ 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 primary limitation on the flats. Both decrease with depth.
- Tissue tests on ryegrass and clover identified deficiencies in copper (ryegrass on flats only) and selenium.

Prioritising soil constraints in February 2023.

Soil pit at initial field day, February 2023.

Farmers formed into four groups and developed an agronomic package according to what they thought needed to be done. Each 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 were:

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

The tables below outline each group's package, with their management decisions being implemented by agronomist Graham Mussell from TopSoil Agriculture.

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.

***Tables 1-4**: Agronomic packages and management actions for each group*

Date	Soil pH group	$/ha Slope	$/ha Flat
15-Apr	Limed 5t/ha	$212	$212
16-Apr	Cultivated	$20	$20
17-Apr	Dragged & rolled	$15	$15
4-May	Sprayed 1.5 L glyphosate + 100 mls bifenthrin	$15	$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	$251	$251
21-Jun	Cut/Graze		
26-Jun	Reset to 6 cm with mower		
28-Jun	75kg/ha SoA (15kgN, 18kgS); 3kg/ha ZnSO4 (0.7kgZn), 2kg/ha CuSO4 (0.5kgCu), 4kg/ha MnSO4 (1.1kgMn); 50kg/ha MOP on flats (25kgK).	$72	$132
3-5 Aug	Cut/Graze		
7-Aug	Reset to 6 cm with mower		
30-Aug	Topdress 55kg/ha urea (25kgN)	$44	$44
22-Sep	Cut/Graze		
28-Sep	Grazing residual measured and reset to 6cm with mower		
	55kg/ha Urea after Sept cut	$44	$44
20&27 Oct	Cut/Graze		
2-Nov	Grazing residual measured		
	Total Cost per hectare	**$673**	**$733**

Date	Plant Biology	$/ha
15-Apr	Limed 2.5t/ha	$106
17-Apr	Sown: 15 kg humates, 25 kg regen blend, 2 kg pillar, 2 kg sodbuster - rolled	$225
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 (23kgN) 20kg/ha kg kieserite (3.2kgMg, 3.6kgS) 0.6 kg/ha Selcote (6gSe)	$66
21-Jun	Cut/Graze	
26-Jun	Reset to 6 cm with mower	
20-Jul	Sprayed 40 L/ha Biosoil Bio+Min	$210
3-5 Aug	Cut/Graze	
7-Aug	Reset to 6 cm with mower	
21-Aug	Spray 250g/ha Boron (0.5kgB)	$11
30-Aug	Topdress 66kg/ha super (6kgP, 6.6kgS), 43kg/ha urea (20kgN), 48kg/ha Sulphate of potash (20kgK, 8kgS)	$156
22-Sep	Cut/Graze	
28-Sep	Grazing residual measured and reset to 6cm with mower	
29-Sep	Topdress 66kg/ha super (6kgP, 6.6kgS), 43kg/ha urea (20kgN), 48kg/ha Sulphate of potash (20kgK, 8kgS)	$156
20&27 Oct	Cut/Graze	
2-Nov	Grazing residual measured	
	Total Cost per hectare	**$953**

Date	Rippers	$/ha Slope	$/ha Flat
15-Apr	Limed 2.5 t/ha	$106	$106
16-Apr	Cultivated	$20	$20
17-Apr	Dragged & rolled	$15	$15
4-May	Sprayed 1.5 L glyphosate + 100 mls bifenthrin	$15	$15
5-May	Sown: 30 kg Astound, 2 kg Sodbuster, 2 kg Taipan, 2 kg Shaftal	$178	$178
5-May	Ryegrass seed treatment	$36	$36
15-Jun	Ripped to 400 mm depth	$60	$60
21-Jun	Cut/Graze		
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	Cut/Graze		
7-Aug	Reset to 6 cm with mower		
22-Sep	Cut/Graze		
28-Sep	Grazing residual measured and reset to 6cm with mower		
30-Aug	Slope 60kg/ha Super Potash 3:1 (4kgP, 7kgK); Flat 180kg/ha Super Potash 3:1(12kgP, 22K, 14kgS); 100kg/ha urea (46kgN)	$121	$223
20&27 Oct	Cut/Graze		
2-Nov	Grazing residual measured		
	Total Cost per hectare	**$586**	**$841**

Date	Meat & Tatties (M&T)	$/ha Slope	$/ha Flat
16-Apr	Cultivated	$20	$20
17-Apr	Dragged & rolled	$15	$15
4-May	Sprayed 1.5 L glyphosate + 100 mls bifenthrin	$15	$15
5-May	25 kg Astound, 2.5 kg Taipan, 2.5 kg Shaftal (treated)	$151	$151
5-May	Ryegrass seed treatment	$30	$30
10-May	Spray 3 kg/ha CuSO4 (0.75kgCu) on soil	$29	$29
21-Jun	Cut/Graze		
26-Jun	Reset to 6 cm with mower		
28-Jun	90kg/ha NS31 (31kgN, 10kgS); 750 ml/ha Tigrex + 25g Broadstrike	$92	$92
3-5 Aug	Cut/Graze		
7-Aug	Reset to 6 cm with mower		
7-Aug	120kg/ha NKS32 (30kgN, 15kgK, 6.6S)	$108	$108
30-Aug	180kg/ha grazeburst (45kgN, 7kgP, 15kgK, 11kgS)	$180	$180
22-Sep	Cut/Graze		
28-Sep	Grazing residual measured and reset to 6cm with mower		
29-Sep	55kg/ha Urea (25kgN) Slope; 110kg/ha urea (50kgN) Flat	44	88
20&27 Oct	Cut/Graze		
2-Nov	Grazing residual measured		
	Total Cost per hectare	**$684**	**$728**

The trial site. Package strips were measured in two "landforms" - Slope (rear) and Flat (foreground).

Results

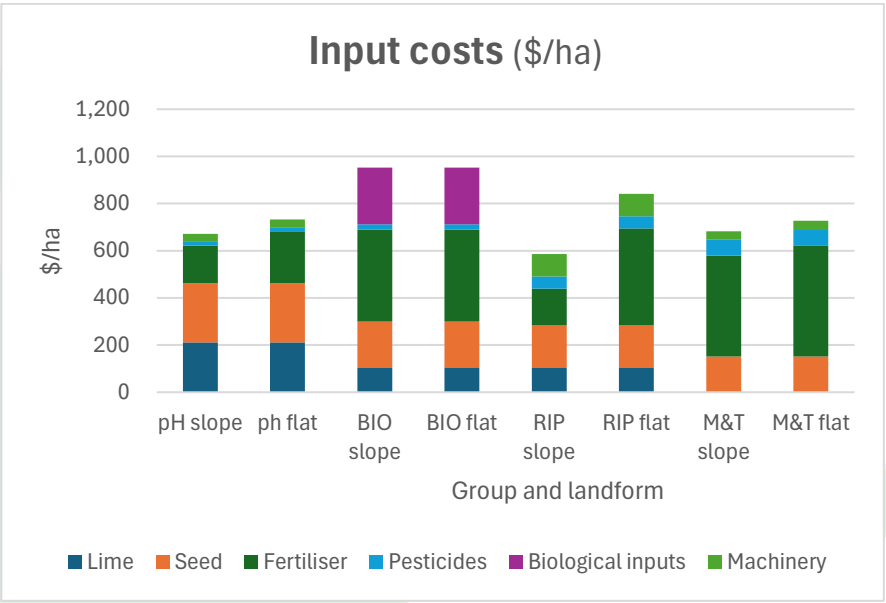

Figure 1: *Inputs costs for each group, divided by landform with costs categorised.*

	Lime	Seed	Fertiliser	Pesticides	Biological	Machinery	TOTAL
pH slope	212	251	159	15	-	35	**672**
ph flat	212	251	220	15	-	35	**733**
BIO slope	106	194	389	23	241	-	**953**
BIO flat	106	194	389	23	241	-	**953**
RIP slope	106	178	156	51	-	95	**586**
RIP flat	106	178	411	51	-	95	**841**
M&T slope	-	151	428	69	-	35	**683**
M&T flat	-	151	472	69	-	35	**727**
AVERAGE	**141**	**194**	**328**	**40**	**241**	**55**	**768**

Table 5. *Input Costs ($/ha) compared to average across the entire trial.*

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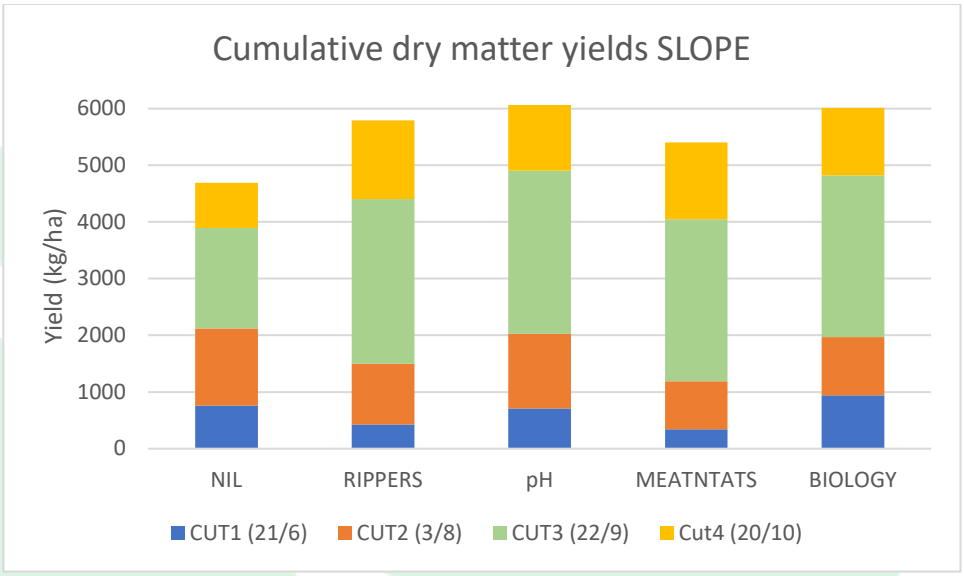
South West NRM

Table 6: *Amount of each element applied in fertilisers. Two figures indicate a differences in the total applied to the slope and flat landform (slope/flat). All elements were topdressed except cells shaded green (foliar application) and light red (liquid applied to soil).*

	Kg/ha of Element Applied			
	RIP	**pH**	**M&T**	**BIO**
N	63	65	85/110	63
P	16/24		7	12
K	18/44	0/25	30	40
S	18/28	18	17	32
Mg				3.2
Mn		1.1		
Cu		0.5	0.75	
Zn		0.7		
B				0.5
Se				0.006



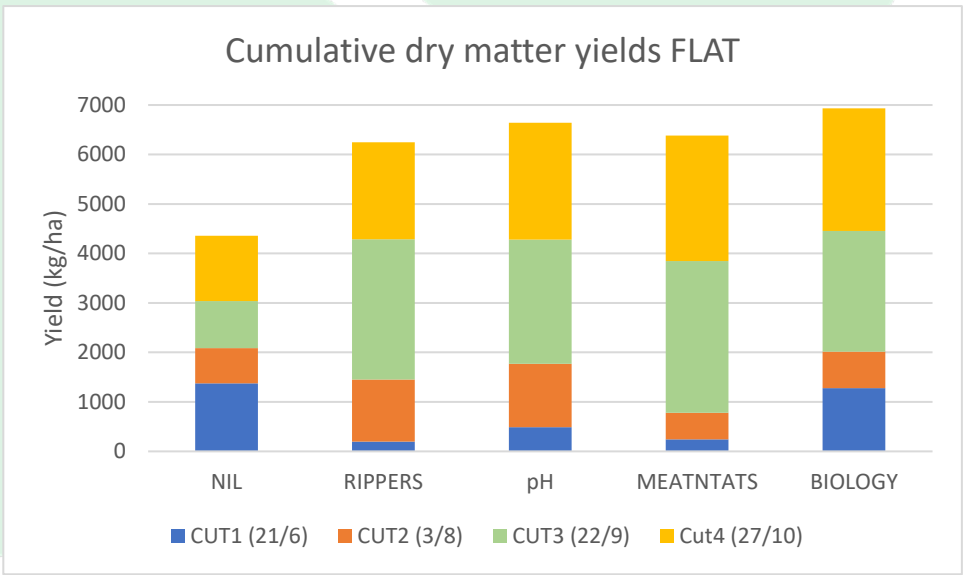


Figure 2. *Total dry matter yield for (a) the slope and (b) the flat.*

Figure 3. *Utilised feed on Slope (top) and Flat (bottom). Measured in September and October only.*

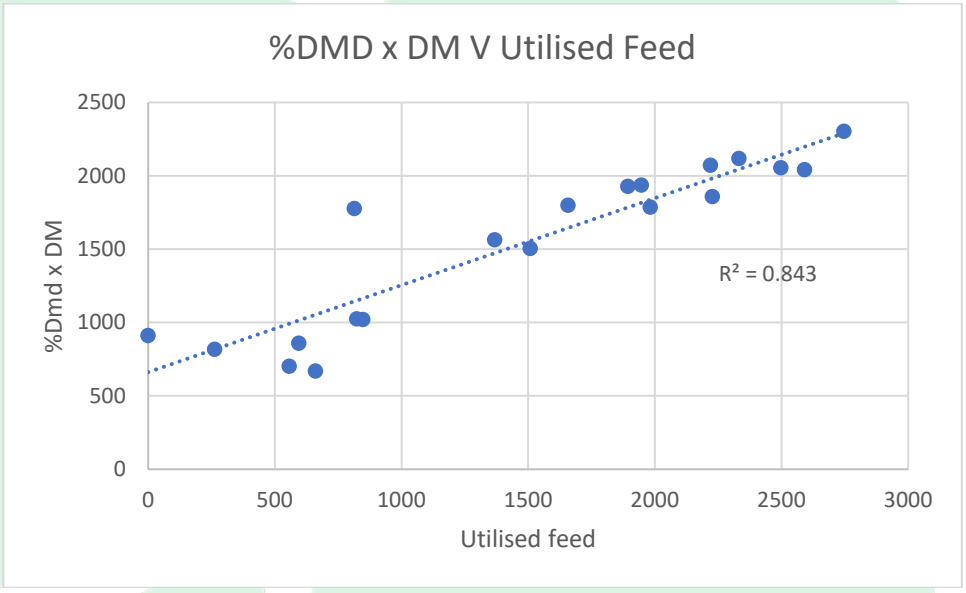


Figure 4. *Relationship between Utilised Feed and percent Dry Matter Digestibility x Dry Matter yield.*

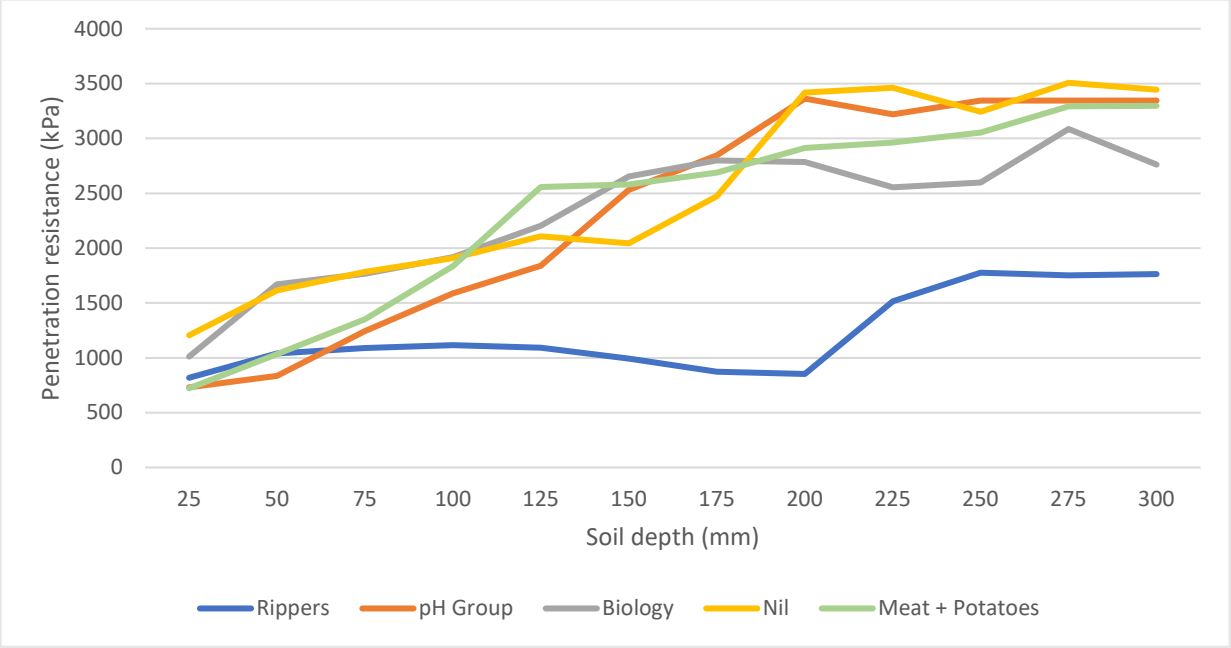


Figure 5. *Penetration resistance. In general, root growth starts to be restricted above 1500 kPa and is severely restricted above 2500 kPa. Results suggest that ripping in June has removed severe compaction.*

	Soil pH	Biology	M&T	Rippers	Nil
Average number of pink nodules per clover plant*	12	11	10	11	6
Visually healthy roots (% white roots estimate)*	64	38	53	55	32
Average dry root weight*	0.93	0.9	0.77	0.94	0.62
Root weight (kg/ha)10-20cm (slope only)**	1249	326	950	1882	1323

Table 7. *Visual assessment of clover nodule and root health. * Measured from 20 plants per group sampled In late August. ** Taken from 27 soil cores (19 mm diameter) sampled on November 30.*

Treatment	*Pratylenchus* (nematode) *	*Didymella /Phoma pinodella* **	*Pythium* **	*Rhizoctonia* **	*Aphanomyces* ***	*Phytophthora* **
Nil Slope	9	128	115	21	1	1160
M&T Slope	11	29	52	0	5	0
Ripper Slope	2	60	154	22	0	362
Biology Slope	32	43	63	10	2	575
pH Slope	20	51	34	30	0	82
Nil Flat	0	285	8	35	24	1425
M&T Flat	0	85	159	5	6	16
Ripper Flat	0	111	49	1	23	61
Biology Flat	0	321	10	197	1	111
pH Flat	0	18	16	45	0	0

Table 8. *SARDI Pasture Legume (Nematode and disease) Test. * Nematodes / g soil; ** pgDNA/g Sample; *** kDNA copies/g Sample*

Group/Landform	Depth	pH Level (CaCl2)
pH Slope	0-10	6.4
pH Slope	10-20	4.6
Biology Slope	0-10	6.0
Biology Slope	10-20	4.6
M&T Slope	0-10	5.4
M&T Slope	10-20	4.5
Nil Slope	0-10	5.8
Nil Slope	10-20	4.7
Ripper Slope	0-10	5.8
Ripper Slope	10-20	4.6
pH Flat	0-10	5.6
pH Flat	10-20	5.1
Biology Flat	0-10	5.3
Biology Flat	10-20	5.1
M&T Flat	0-10	5.1
M&T Flat	10-20	5.1
Nil Flat	0-10	5.0
Nil Flat	10-20	5.0
Ripper Flat	0-10	5.4
Ripper Flat	10-20	5.1

***Table 9**. Difference in soil pH between treatments. The pH group applied 5T/ha and Biology and Rippers applied 2.5T/ha. Lime was incorporated into pH and Ripper plots only.*

Group/Landform	Ave ME	Ave Protein
M&T Flat	12.0	17.5
M&T Slope	11.7	20.6
Ripper Slope	11.3	19.2
Ripper Flat	11.7	18.2
pH Flat	11.7	15.7
pH Slope	11.3	17.9
Biology Flat	11.3	16.3
Biology Slope	10.6	16.9
Nil Flat	11.0	15.3
Nil Slope	10.4	17.9

***Table 10.** Average Metabolisable Energy (ME) and Crude Protein across three cuts in August, September and October.*

This project is delivered by the South West NRM and supported by Western Beef Association Inc under the Soil Wise project, funded by the National Landcare Program – an Australian Government initiative, and supported by Healthy Estuaries WA – a State Government program.

Accurate soil sampling

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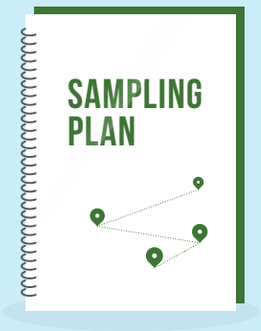
The three key areas of PLAN, SAMPLE AND DISPATCH must be done correctly to help achieve sound soil and plant nutrition recommendations. The practices identified below should be followed.

plan

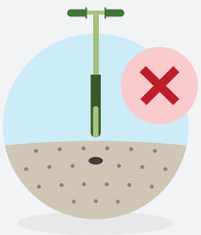
1 Develop a fit for purpose sampling plan.



2 Samples must be representative of soil, crop and land management.

3 Sample at the same time each year for monitoring and predictive purposes

4 Don't sample for 3 months after adding fertiliser or soil amendment, given rainfall and soil disturbance requirements are meet.



sample

5 Use appropriate sampling equipment.

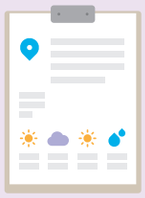
6 Use safe and clean practices.

7 Collect a minimum of 20-40 cores depending on core diameter.

8 Sample to the correct depth for enterprise and issues.

9 Avoid atypical area such as stock camps.

10 Record sampling location, equipment, depths, date and conditions.



dispatch

11 Keep sample cool, dark and avoid contaminants.

12 Send to lab promptly or store in fridge (4°C) briefly.

13 Ensure sample forms are correctly filled out.

14 Follow relevant biosecurity procedures.

Accurate soil sampling

FERTCARE®

plan

Clearly defining the reasons why sampling is undertaken is essential when developing a sampling plan. “What is the question your client wants answered?” Which of the following reasons are you sampling?

- Predictive (which nutrients do I need and how much?),
- Monitoring (have my soil nutrient concentrations changed over time?),
- Diagnostic (explaining spatial differences in crop and pasture growth), or,
- Compliance (meeting industry or regulatory requirements).

Once you have defined the reason for sampling, you can then decide on:

- The area to sample, based on similarity in soil, crop and land management,
- a sampling pattern, and
- when to sample.

sample

- Select and check “fit for purpose” sampling equipment.
- Ensure cleanliness through the sampling and handling procedure while also following work health and safety guidelines.
- Identified sampling areas should aim to reduce variability and represent similarity in soil type, crop and land management.
- Take at least 20 - 40 cores per composite sample. Smaller diameter samplers need more cores. Err on the side of taking more cores particularly as soil and crop variability increases.
- Sample the correct depth for the crop or pasture and issues to be addressed.
- Avoid atypical areas such as stock camps, fence lines and gateways, tree lines, previous fertilizer and lime dump sites, timber burns, headlands and poorly drained areas.
- Record geo-coordinates of sample patterns, sampling equipment used, depth, date and field conditions.

dispatch

- Protect collected soil samples from heat, sun and contamination.
- Send to the laboratory shortly after collection. Avoid mailing samples toward the end of the week. Samples may be stored briefly in a refrigerator at 3 – 5°C prior to dispatch.
- Fill out all details on the sample submission forms or in a sampling app.
- Follow relevant biosecurity requirements regarding sampling equipment and movement of samples when traveling between farms and shipping samples across state borders.

For more information, read the **Fertcare Soil Sample Guide** by scanning this QR code.

Accurate as of **April 2020**

Rumen8-Beef Training

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Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

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WESTERN BEEF Association Inc

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- Compare various management scenarios.
- Better understand nutritional principles so to select better feed.

Strictly limited participant numbers

Participants need to bring their own laptop

Tuesday 27 February - Bridgetown

Wednesday 28 February - Mandurah

Directions given upon registration

Time: 9 am - 4 pm

Cost:

Western Beef Financial Members: $25

Non-members: $ 35

Registration includes: Lunch, morning and afternoon tea and notes.

Registrations will close 5 days prior to event or before, if sold-out.

Follow the link to register:

https://www.trybooking.com/CPFMQ

For more info, contact Western Beef EO on: Jeisane.alis@gmail.com or on 0403 327 216

Event's partners

South West NRM

PHCC Working Together Peel-Harvey Catchment Council

This project received funding from the Australian Government's Future Drought Fund.

GEOGRAPHE FARMERS
Protecting Geographe Bay

GeoCatch

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It supports producers to improve grazing, fodder and feed decisions and meets eight times over a 12-month period, at host farms across the region.

Expressions of Interest open in January 2024, with the program beginning in April.

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SCAN ME

This project is jointly funded through GeoCatch, Meat and Livestock Australia's Profitable Grazing Systems initiative and Western Beef Association Inc.

WESTERN BEEF Association Inc

Profitable Grazing Systems your pathway to success

mla MEAT & LIVESTOCK AUSTRALIA

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HEALTHY ESTUARIES WA

Revitalising Geographe Waterways
VASSE taskFORCE

This is a part of the State Government's Healthy Estuaries WA and Revitalising Geographe Waterways programs, and Soil Wise. Soil Wise is funded by the National Landcare Program Smart Farms Small Grants Initiative - an Australian Government program.