Improving Production on Sandy Soils Update - Coomandook

9.00am Workshop
1.00pm Farm Walk *catering provided*
Thursday 28th September 2023

REGISTRATIONS for catering;
tstrugnell@coorong.sa.gov.au or
text on 0427 750 050
Register by Monday 25th Sept

What you will see & hear?

- Sandy Soil Projects Update
- Understanding soil biology & links to production
- Booderoo Sandy Soils Treatments site results
- Treatments to improve veldt grass production & feed value
- Boosting Feed Quality & Livestock Production on Sandy Soils

What do you want to try out next?

Full program on next page

Speakers

Dr Mel Fraser	Soil Function Consulting
Dr Ashley Martin	Microbiology Laboratories Aust
Dr Michael Wilkes	MW Livestock Co
Felicity Turner	Turner Agriservices
Booderoo Farm Managers	

Coorong District Council

Coorong Tatiara Local Action Plan

CHISEL PLOUGH

ACTIVE MIX

DEEP RIP

INVERSION

MLA MEAT & LIVESTOCK AUSTRALIA

Australian Government | National Landcare Program

Australian Government Department of Agriculture, Fisheries and Forestry | Future Drought Fund

LANDSCAPE SOUTH AUSTRALIA LIMESTONE COAST

This event is jointly funded through Australian Government's National Landcare Program, Future Drought Fund and the Limestone Coast Landscape Board

Improving production on Sandy Soils Update
Thursday 28th September 2023

9.00am – 3.30pm Coomandook Uniting Church or Main Hall TBC
'Booderoo' – 572 Flowery Plain Road - Coomandook

	Item	Speaker	Organisation	Funding Body	Time	Page
1	MEETING POINT **Coomandook Uniting Church or Main Hall TBC**	WELCOME Tracey Strugnell	Coorong Tatiara Local Action Plan	Coorong Tatiara Local Action Plan	**9.00am**	2
2	**Overview of Sandy Soils Projects in our District**	Dr Mel Fraser	Soil Function Consulting	Meat & Livestock Australia GRDC	**9.10am**	3-6
3	**Understanding soil biology and links to production**	Dr Ashley Martin	Microbiology Laboratories Australia	Meat & Livestock Australia	**9.30am**	3-6
	MORNING TEA				**10.30am**	
3	**Understanding soil biology and links to production** *continued*	Dr Ashley Martin	Microbiology Laboratories Australia	Meat & Livestock Australia		3-6
	LUNCH				**12.00pm**	
4	**BOODEROO – Sandy Soil Production Site – Meat & Livestock Australia & Plozza Sites** *Impact of treatments on fodder production and quality, and soil health, trial results*	Dr Mel Fraser	Soil Function Consulting MLA	Meat & Livestock Australia	**1.00pm**	7-10
5	**Boosting Feed Quality and Livestock Production on Sandy Soils – implications of amelioration on feed quality**	Dr Michael Wilkes	MW Livestock Co	Meat & Livestock Australia		11-17
6	**BOODEROO LUNCH SHED**				**2.30pm**	
	Veldt Grass and sandy soil production in our landscape	Dr Mel Fraser	Soil Function Consulting	National Landcare Program		18-24
	Overview of MLA and GRDC Sandy Soils Project Results – what are we learning over time	Felicity Turner	Turner Agri	Meat & Livestock Australia		
	Introducing CT Soil Hub Web Site	Tracey Strugnell	Coorong Tatiara Local Action Plan	Future Drought Fund Coorong Tatiara Local Action Plan		
	WHERE TO FROM HERE / FUTURE OPPORTUNITIES – cropping and grazing systems			**EVALUATION SHEET**		**25 - 26**
	Refreshments and Discussion				**3 – 3.30pm**	

MAKING SENSE OF BIOLOGICAL INDICATORS

Biological indicators give information on living organisms in soil. Biological indicators of soil quality therefore measure *dynamic* soil properties, i.e. properties that change over time and/or with management. It is important to monitor biological indicators as they respond more quickly to changes in management or environment than physical and chemical indicators.

For most biological indicators, there is little evidence currently available which directly links the value of the indicators to productivity or, in some cases, the risk of adverse environmental impact. However, there is good evidence from field trials carried out on a range of soils in Australia of links between biological indicators and soil processes. These have been used to create guideline ranges for the biological indicators, similar to those used for the dynamic physical and chemical indicators.

- Indicators falling in the **RED** zone are high risk and need to be investigated urgently.
- Indicators falling in the **AMBER** zone are moderate risk and should be investigated further.
- Indicators falling in the **GREEN** zone are low risk, regular monitoring should be continued.

Diseases and Nematodes

Indicators of soil inoculum status for soil borne disease and/or nematode abundance are used to guide practical paddock by paddock decisions about using control measures. The pathogen–host cycles are complex and affected by a range of environmental, crop and management factors (see Take-all Disease, Cereal Cyst Nematode, Root Lesion Nematode fact sheets). Because the pathogens are highly variable across a paddock, it is very important to use an appropriate sampling strategy to gain results that are representative of the paddock (figures 1 & 2). A medium or high value obtained as part of routine soil monitoring may not lead to a high risk of the disease or significant yield loss. Approaches to managing pathogens need to be specific to each paddock and farmers should seek the advice of an appropriately qualified agronomist.

Risk rating for Disease and Nematodes

below detection	low	medium	high

Figure 1: *Cereal cyst nematode will cause distinct patches of yellowed and stunted plants. Note the likeness of symptoms to poor nutrition or water stress. (Photo by Vivien Vanstone, DAFWA, Nematology.)*

Figure 2: *Patchiness in crop caused by Root lesion nematode. (Photo by Vivien Vanstone, DAFWA, Nematology.)*

Total organic carbon

Organic matter in soil refers to all the materials that are or were associated with living organisms. It is difficult to measure directly and total organic carbon (usually expressed as %C—the percentage of carbon in the soil), is measured instead. The value for total organic carbon can be converted to give tonnes of carbon per hectare using information about bulk density and gravel content (see Total Organic Carbon fact sheet). Low levels of total organic carbon can indicate that there might be problems with unstable soil structure, low cation exchange capacity and nutrient turnover. Where total organic carbon in a paddock is lower than the soil's capacity to store organic matter it may be increased by increasing ground cover, reducing fallow, retaining stubble, increasing the proportion of pasture in the rotation or other management strategies that increase inputs of organic materials into the soil.

Total organic carbon (%C) in sand soil

Total organic carbon (%C) in loam soil

Total organic carbon (%C) in clay soil

Total organic carbon can be separated into its components (termed fractions or pools) which differ in their chemical structure. The labile pool which turns over relatively rapidly (<5 years), results from the addition of fresh residues such as plant roots and living organisms. In contrast, resistant residues are slower to turn over (20–40 years) because they are physically or chemically protected. Soils in Australia also contain charcoal as a result of burning which is almost totally recalcitrant. The proportion of total organic carbon in the labile fraction can be used to identify soils with low amounts of regular residue input. In sand soils, 10% of the total organic carbon should ideally be in the labile fraction; in loam soils 15% and in clay soils 20%.

Microbial biomass

The size of the soil microbial biomass (measured as mg C per kg) is affected by climate and many soil properties (see Microbial Biomass fact sheet). Microbial biomass is the powerhouse of almost all biological processes in soil (figure 3). Generally up to 5% of the total organic carbon can be found in the living tissues of the microbial biomass.

Microbial biomass (mg C/kg soil)

Microbial biomass (% of total organic carbon)

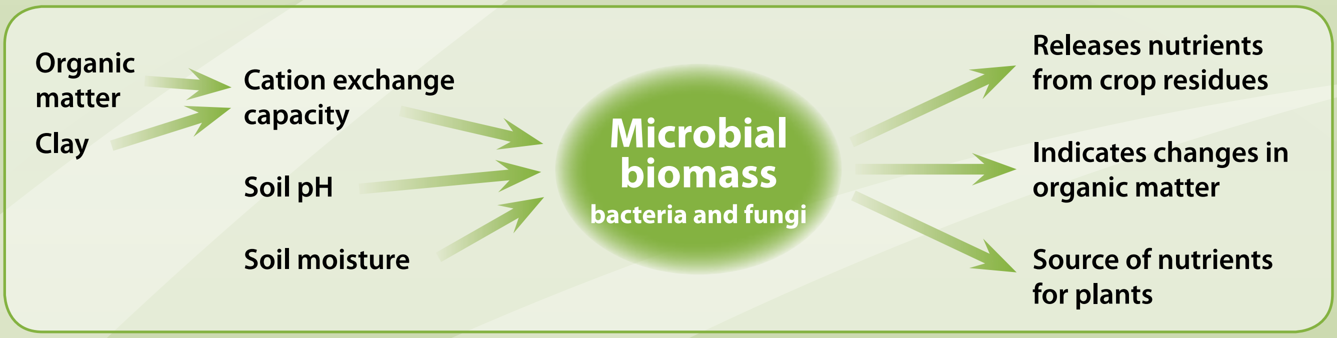

Figure 3: *The main soil properties affecting the microbial biomass and factors influenced by it.*

Author: **Elizabeth Stockdale** (Newcastle University, UK)
Prepared based on findings from soil quality expert panel workshops

This soilquality.org.au fact-sheet is supported by funding from Wheatbelt NRM under the Caring for our Country Program.

wheatbelt natural resource management
CARING FOR OUR COUNTRY

INTERPRETING MICROBIAL BIOMASS CARBON

Key points

- Microbial biomass is a measure of the weight of microorganisms in soil.
- A challenge in interpreting values of microbial biomass is knowing the attainable microbial biomass for a given land use and what level may constrain production.
- The best way to use microbial biomass values in soil quality monitoring is to measure microbial biomass regularly over time using soil collected during the summer months.
- An estimate of the attainable microbial biomass carbon is 5% of the organic carbon in soil.

Background

Microbial biomass is a measure of the weight of microorganisms in soil, which mostly consists of bacteria, fungi and other microbes called archaea. Measures of microbial biomass usually measure either the weight of carbon or nitrogen in soil microorganisms.

A challenge in interpreting values of microbial biomass is the difficulty of knowing the attainable microbial biomass for a given land use and what level of microbial biomass may constrain production.

Microbial biomass to monitor soil quality

Microbial biomass is a useful indicator of soil quality. Soil microorganisms are involved in several processes that influence soil quality and microbial biomass changes rapidly in response to changes in soil properties (see Microbial Biomass fact sheet).

Single measurements of microbial biomass can be difficult to interpret, but trends over time are a relatively simple way of assessing the effect of management on soil microorganisms.

Increases in microbial biomass over time are considered beneficial. They may indicate an increase in beneficial biological functions in soil and a future increase in organic carbon content in soil. In contrast, a decline over time is considered to have a negative effect on soil quality.

The best time to sample microbial biomass is during the dry summer months when soil is collected for chemical analysis by commercial laboratories. Microbial biomass varies greatly during the year, however during summer, it is more stable because both organic carbon inputs and soil water are low (see Microbial Biomass fact sheet).

Soil type determines the potential microbial biomass

The potential microbial biomass of a soil is the maximum microbial biomass that could be sustained by the soil if no other factors were limiting microbial biomass. It is determined by inherent soil properties, especially clay content and soil pH (figure 1). The potential microbial biomass of a soil is rarely achieved because climate factors decrease microbial biomass.

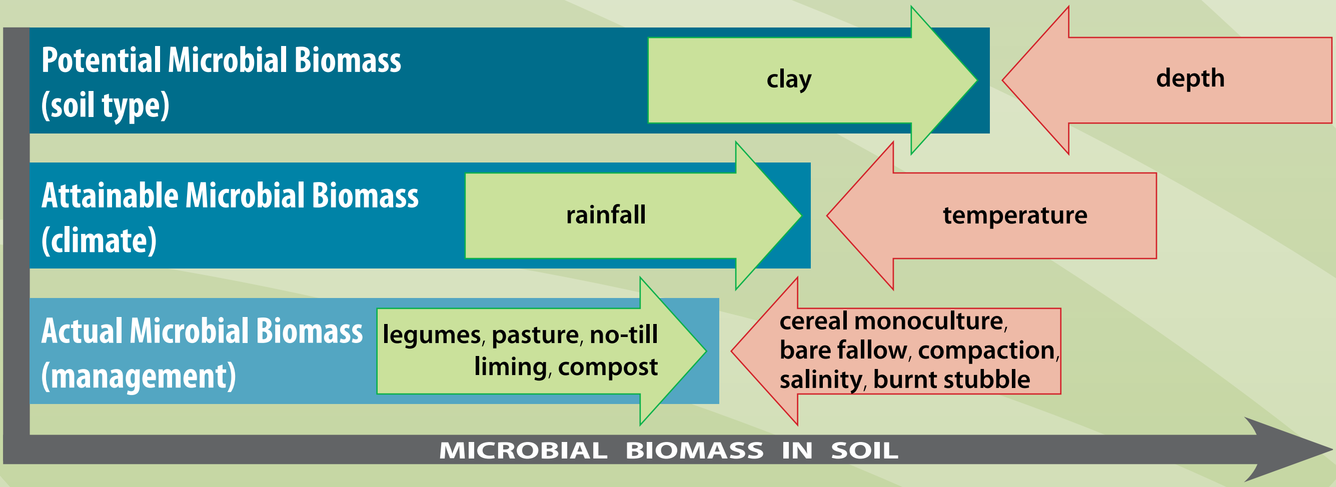

Figure 1: *How soil type, climate and management influence the potential, attainable and actual microbial biomass for a given soil. Based on concepts in Ingram and Fernandes (2001).*

Climate determines the attainable microbial biomass

The attainable microbial biomass is the maximum level that can be expected in a soil under a particular land use. It is mostly determined by the climate because climate influences soil water content and inputs of organic carbon to soil (figure 1). Low soil water content and low inputs of organic carbon are the two factors that most limit microbial biomass in Australian soils.

The attainable microbial biomass varies depending on land use because different land uses support different inputs of organic matter to soil. In the same paddock the attainable microbial biomass will generally be lowest under cropping, higher under pasture and highest for forestry.

Management determines actual microbial biomass

The actual microbial biomass is determined by management practices (figure 1). The microbial biomass is increased by management practices that increase inputs of organic carbon to soil and improve the chemical and physical conditions experienced by microorganisms in soil.

Estimating the attainable microbial biomass

Land managers can estimate the attainable microbial biomass for their soil using the organic carbon content of the soil. Microbial biomass carbon is rarely more than 5% of the total organic carbon in soil. Therefore 5% of the organic carbon content of the soil represents an estimate of the attainable microbial biomass carbon for that soil. The actual microbial biomass is generally lower than the attainable microbial biomass (figure 2).

Another way to determine the attainable microbial biomass is to estimate the microbial biomass for a 'best-practice' land use on a similar soil in the same region. For example, in a Western Australian catchment computer modelling was used to determine the microbial biomass under perennial pasture for soils with a range of clay contents, as indicated by cation exchange capacities. These values were used as an estimate of the attainable microbial biomass for the catchment. When the attainable microbial biomass was compared to the actual microbial biomass values for the catchment, it showed that few soils in the catchment were achieving the attainable microbial biomass (figure 3).

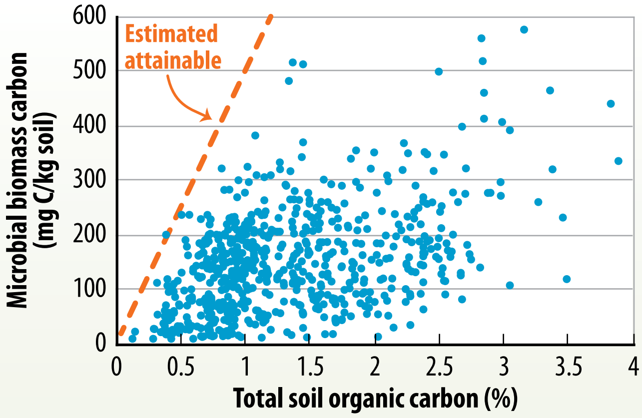

Figure 2: *In most agricultural and horticultural soils in Western Australia, the actual microbial biomass carbon (dots) is lower than the estimated attainable microbial biomass carbon (5% of total organic carbon) (line) (Gonzalez-Quinones et al. 2011).*

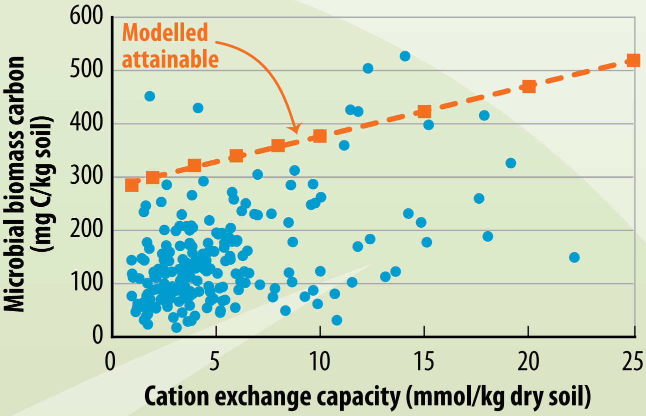

Figure 3: *Actual microbial biomass carbon for agricultural soils in a Western Australian catchment (dots) was usually lower than the attainable microbial biomass predicted by modelling (line) (Gonzales-Quinones et al. 2011).*

Further reading and references

Gonzalez-Quiñones V, Stockdale EA, Banning NC, Hoyle FC, Sawada Y, Wherrett AD, Jones DL, and Murphy DV (2011) 'Soil microbial biomass—Interpretation and consideration for soil monitoring', *Australian Journal of Soil Research*, **49:** 287–304.

Ingram JSI and Fernandes ECM (2001) 'Managing carbon sequestration in soils: Concepts and terminology', *Agriculture, Ecosystems & Environment*, **87:** 111–117.

Authors: **Vanessa Gonzalez-Quiñones** (The University of Western Australia) and **Jennifer Carson** (Ghost Media)

The University of Western Australia
Achieving International Excellence

The National Soil Quality Monitoring Program is being funded by the Grains Research and Development Corporation, as part of the second Soil Biology Initiative.

GRDC Grains Research & Development Corporation
Your GRDC working with you

Soil Biology Initiative II
Supported by the GRDC

IMPROVED GRAZING PRODUCTION ON NON-WETTING SANDS

DEEP TILLAGE & COMPOST CASE STUDY

This case study explores the effectiveness of deep ripping, soil mixing and nutrition on fodder growth.

AT A GLANCE

Challenges

- Sandy soils are naturally deficient in most essential plant nutrients and are prone to compaction.

Opportunities

- Deep tillage can overcome compaction and reduce water repellence.
- Nutrient deficiencies can be addressed with fertilisers and organic amendments such as aged animal manure.

We've had a lucerne stand in this paddock gradually declining over time, so it was due for renovation. We've used the Plozza plow on deep sand before, with varied success.

This demonstration will help us work out which machine is best suited to the job and whether there are additional benefits with adding manure.

Arran Loechel

Manager, Booderoo, Coomandook

BACKGROUND

An 24ha pasture paddock at Coomandook was selected to demonstrate strategies to overcome sandy soil constraints. The paddock is characterised by deep sandy soils (Image 1) and a heavy loam flat on the southern end, where limestone is intercepted from 30cm.

Soil sampling in 2021 confirmed the paddock to be moderately water repellent and deficient in potassium. The deep sand had high soil strength below 25cm, indicating compaction and had low nutrient retention capacity throughout.

Consultation with local farmers confirmed they were interested in testing deep tillage strategies to treat high soil strength along with implements that invert or intensively mix the soil profile to treat water repellence, which is a very common constraint in the district. Aged piggery manure + bedding straw is available locally and there was interest in its use to boost nutrient fertility and lower erosion risk post-amelioration.

In autumn 2022, treatments were applied on plots 0.4 ha in size to:

- Dilute water repellent surface soil layers.
- Treat deep soil compaction.
- Treat nutrient deficiencies using both mineral fertiliser and aged piggery manure.

These treatments are tested against 3x no-tillage controls (Image 2) and will be monitored until 2025.

Image 1. Soil profile from the deep sand dune prior to any treatment being applied.

TREATMENT DETAILS

Sulphate of potash was applied across the whole trial site prior to tillage at 125 kg/ha supplying 50K and 20S kg/ha ($220/ha).

Aged piggery manure + bedding was surface applied prior to tillage @ 10 t/ha supplying 322N, 80P, 202K, 49S and 134Ca kg/ha (sourced at no cost).

Inversion: a John Shearer one-way plough fitted with 9 'Plozza Plow' discs was used to invert the surface 30 cm of sand. Approx. $50/ha.

Chisel plough: a Bednar Terraland Chisel Plough was configured with 15 tines on 43cm spacings (6.2m working width) and fitted with Active-Mix tines for the 'mix' treatments; the shape of these tines provides easy soil penetration with optimised loosening to 55cm with some bottom-up and top-down mixing. 'Deep rip' treatments were applied using a narrower shank tine and tip, with no plates. De-compaction and levelling is achieved in one pass using hydraulic spiked roller packers. Approx. $150-165/ha contactor rate.

Image credit: Google Earth

Image 2. Trial map (10 treatments x 0.4ha).

AGED MANURE

INVERSION

CHISEL PLOUGH

ACTIVE MIX

DEEP RIP

Sowing details: A ribbed roller was used to firm the surface of all tillage plots prior to planting a mixed species pasture on 27th May, comprised of 30kg/ha cereal rye, 30 kg/ha vetch, 2 kg/ha grazing brassica and 1 kg/ha of Balansa clover.

Measurements: Normalised difference vegetation index was measured with a Trimble Greenseeker by recording 5 transects across the dune crest in each plot on 19 July.

Dry matter was assessed on 8 September by harvesting 2x0.25m2 quadrats to ground level in 12 locations per treatment. A second biomass assessment was conducted on 2 November (following recovery after grazing) by harvesting 12 x 0.5m2 quadrats. Subsamples were retained for moisture and quality assessment.

YEAR 1 RESULTS

Penetration resistance (PR) is a measure of soil strength, indicating the presence of compacted or hard set soils. Plant root growth is restricted in soils with high strength, particularly when the PR exceeds 2,500 kilopascals (kPa; black dotted line, Figure 1).

- PR in the No tillage control showed soil strength increasing down the profile from moderate to severe, exceeding 2,500 kPa below 35cm (grey line, Figure 1).
- Inverting the soil with the one-way plough reduced the PR in the profile to 40cm.
- Chisel ploughing the soil with the Bednar Terraland reduced the PR throughout the top 50 cm of soil; both tines had the same impact on reducing PR.

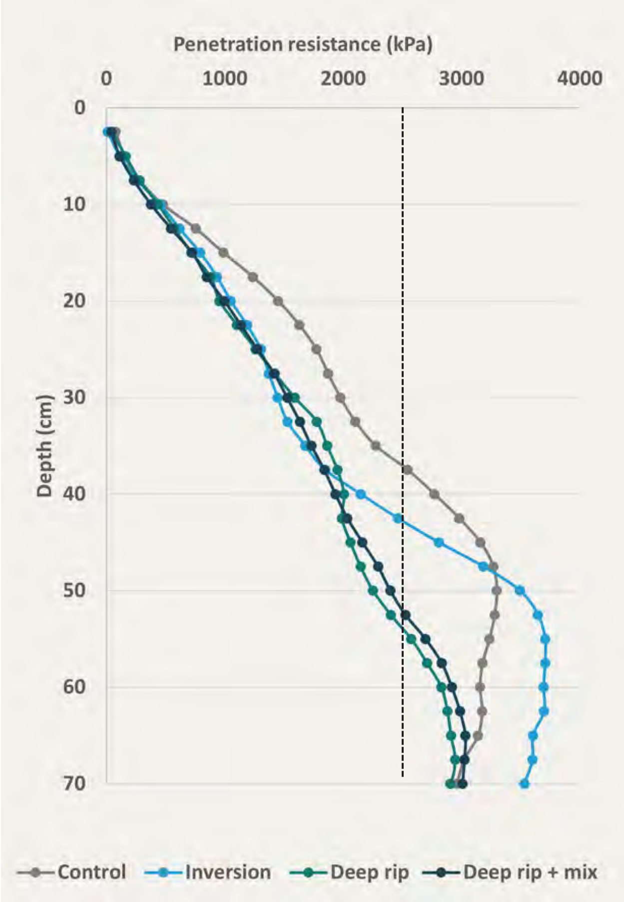

Figure 1. Penetration resistance (kPa) measured in 2022 for each deep tillage type.

Table 1. 2022 production measures: Normalised Difference Vegetation Index (NDVI); dry matter (DM; t/ha) in September; DM in November, following recovery from grazing; dry matter digestibility (DMD); crude protein (CP); metabolisable energy (ME). Treatments with the same letter are not significantly different.

Treatment	NDVI July	DM t/ha September	DM t/ha November	DMD %	CP %	ME MJ/kg
No tillage	0.37 b	1.48 f	4.19 cd	52.6	8.7	7.4
Deep rip + mix	0.31 b	1.36 f	6.55 a	51.4	9.0	7.2
Deep rip + mix + manure	0.49 a	3.66 b	7.23 a	58.1	11.1	8.4
No tillage + manure	0.36 b	1.66 ef	3.63 de	54.5	9.8	7.8
No tillage (control)	0.31 b	1.40 f	3.19 e	62.9	11.3	9.2
Inversion	0.31 b	2.16 de	4.56 bc	63.6	13.0	9.3
Inversion + manure	0.46 a	4.09 ab	6.59 a	53.9	10.6	7.7
Deep rip + manure	0.49 a	4.35 a	5.34 b	59.6	12.5	8.6
Deep rip	0.44 a	2.98 c	3.47 de	61.0	12.5	8.9
No tillage	0.30 b	2.56 cd	3.14 e	61.8	12.2	9.0
LSD (p=0.05)	0.065	0.47	0.34	-	-	-

YEAR 1 RESULTS

Normalised difference vegetation index (NDVI) results indicated enhanced growth in all of the manure treatments in July, but only when combined with deep tillage (Table 1 and photos at right). Deep rip was the only deep tillage treatment that performed better than the three controls in the absence of manure.

Dry matter (DM) measured in September also showed the three deep tillage + manure treatments to be the highest yielding, adding between 1.8 and 2.5 t/ha of additional DM above the average of the three controls (1.8 t/ha; Table 1).

The pasture recovered well from grazing, owing to high spring rainfall. The cereal rye was at early grain fill when DM was assessed in early November. The Deep rip + mix +/- manure treatments were the highest producing at this sampling time, yielding >6.5 t/ha of DM (3 t/ha more than the average of the three controls = 3.5 t/ha). This additional yield often came at the expense of dry matter digestibility, but there were no consistent trends in crude protein or metabolisable energy (Table 1).


No tillage control - NDVI 0.31


Inversion - NDVI 0.31


Deep rip + mix + manure - NDVI 0.49

WHERE TO NEXT?

- The cereal rye will be harvested for seed and the stubble will be slashed and possibly grazed over the summer.
- The paddock will likely be sown to an annual fodder crop in 2023; soil and pasture monitoring will continue.

Acknowledgements: Many thanks to Tim and Cheryl Freak and Arran and Anika Loechel for access to paddocks, equipment and resources to deliver this case study. Thanks also to the project Steering Committee for ongoing support.

This project is supported by **Meat and Livestock Australia** and the **Coorong Tatiara Local Action Plan - Coorong and Tatiara District Councils**.

Project Duration: July 2019 to June 2026

Project manager: Dr Melissa Fraser, Soil Function Consulting. E:mel@soilfunction.com.au M:0407 773 369

Improved Grazing Production on Non-wetting Sands
Booderoo 2022 Pasture DM and DSE assessment

1. Methods

Utilising the data generated from pasture assessments conducted at Booderoo in September and November 2022, an assessment of forage quality, biomass production and potential increase in carrying capacity and gross margin was undertaken. The key assumptions and equations utilised for each assessment are as follows:

1.1 Forage quality assessment

An assessment of pasture quality and a prediction of potential energy intake for two classes of livestock (60kg ewe and 500kg cow) were undertaken using the following equations:

1.1.1 Forage quality parameters

1 Dry Sheep Equivalent*= 8.3 Megajoules of Metabolisable energy*

Intake Potential*=(120/NDF) X Liveweight (kg)*

Metabolisable Energy Intake potential (MEI)= *Intake potential (kg) X Pasture ME (MJ/kg DM)*

Metabolisable Energy requirement difference (MER) (MJ/day)= *MEI-DSE rating X 8.3 MJ*

Intake predictions were undertaken for a 60kg Merino ewe with a lamb at foot rated at 3.5 DSE (https://makingmorefromsheep.com.au/efficient-pastoral-production/tool_12.14.html), and a *bos taurus* breed cow with a calf at foot at 18 DSE rating (https://mbfp-pastoral.mla.com.au/managing-your-feedbase/determine-carrying-capacity-and-stocking-rate/)

1.1.2 Forage mineral parameters

Grass Tetany Index= *Potassium/ (Calcium + Magnesium)*

Ca:P ratio= *Calcium(%)/Phosphorous(%)*

N:S ratio= *(Crude Protein (%)/6.25)/Sulphur (%)*

2.1 Gross Margin assessment

Based on the biomass cuts, spring feed quality assessment and the actual grazing undertaken on each site, the potential capacity and effects on gross margin were calculated for each treatment based on the following assumptions:

2.2.1 Gross Margin Equations

Predicted Total DSE =
September DM assessment X 10MJ ME/kg + November DM assessment X Feed test MJ ME/kg + Actual DSE of grazing activity undertaken

Total GM ($/ha/yr)=
Predicted Total DSE production x Gross Margin values/DSE/ha grazed/year

2.2.1 Gross Margin Key assumptions

September pasture quality (not tested)= *10 MJ/kg DM*
Pasture utilisation= *100%**
Gross Margin value (Beef)= *$59/DSE/yr***
Gross Margin value (Sheep)= *$65/DSE/yr***

**note as this site was sampled at set times and not at the optimum grazing time 100% utilisation was used to capture the total biomass grown across sites. Variation in forage species, grazing management and environmental conditions will impact the total forage utilisation normally.*

***GM values were sourced from the 2022 Primary Industries and Resources South Australia (PIRSA) Farm Gross Margin and Enterprise Planning guide (https://pir.sa.gov.au/primary_industry/industry_support/farm_gross_margins_and_enterprise_planning_guide)*

2. **Results**

2.1 Forage Quality parameters

Across all quality and intake parameters at Booderoo there was a distinct trend of plots 3-7 having higher values than the remaining plots (Table 1). Given this included a control plot, there may have been some topographical effects on the results, which should be noted throughout the interpretation. The mixed species nature of the crop planted (early maturing cereal rye, mid-late maturing vetch and late-maturing brassica) may also contribute to some spatial variability across the plots.

The Metabolisable Energy (ME) content of the pastures at Booderoo were moderate, ranging from 7.2-9.2 MJ ME/kg DM (Table 1). Crude protein (CP) levels had greater variation, with the control plot recording the lowest value of 8.7%. The Neutral Detergent Fibre (NDF) and resultant digestibility (DMD) observed varied in a similar fashion to ME and CP.

Using the NDF and ME figures to predict potential ME intake of ewes or cows showed that no treatment had sufficient quality to meet the energy requirements. The smallest deficit from requirement was observed in the plozza plow treatment (Plot 6; Table 1).

Table 1: Forage quality parameters and predicted intake potential for 60kg ewe and 500kg cow

					60kg ewe (29 MJ)		500kg cow (149 MJ)	
Treatment	**ME (MJ/Kg DM)**	**CP (%)**	**NDF (%)**	**DMD (%)**	**Predicted ME intake (MJ)**	**ME difference**	**Predicted ME intake (MJ)**	**ME difference**
BOODEROO								
Control (no tillage)	8.5	10.7	53.4	59.1	11.5	-17.5	95.9	-53.5
Control + manure	7.8	9.8	58.8	54.5	9.6	-19.5	79.6	-69.8
Bednar + mix	7.2	9.0	60.8	51.4	8.5	-20.5	71.1	-78.3
Bednar + mix + manure	8.4	11.1	54.1	58.1	11.2	-17.9	93.2	-56.2
Plozza plow	9.3	13.0	48.6	63.6	13.8	-15.3	114.8	-34.6
Plozza plow + manure	7.7	10.6	58.2	53.9	9.5	-19.5	79.4	-70.0
Bednar rip	8.9	12.5	50.7	61.0	12.6	-16.4	105.3	-44.1
Bednar rip + manure	8.6	12.5	50.9	59.6	12.2	-16.9	101.4	-48.0

2.2 Forage mineral parameters

The target mineral ratios for forages grazed by sheep and cattle are as follows:

Grass Tetany Index: <2.2:1
Ca:P: 2:1
N:S: 12-20:1

The Bednar + mix and Plozza plow treatments exhibited a grass tetany index (GTI) rating that was higher than the desired threshold. Both inversion plots (inversion and inversion + manure) GTI were driven by higher potassium levels, whereas the remaining plots with high GTI were influenced by a combination of moderate potassium and low calcium and magnesium.

Interestingly, the Bednar rip without mixing treatments had GTI levels below the threshold due to significantly higher calcium and magnesium levels. Whether this is a mixing or topographical effect remains unknown (Table 2).

The calcium to phosphorous ratios ranged from slightly low (1.6:1, deep rip + mix) to slightly high (2.45:1, deep rip + manure), with no extreme outliers noted. These values are not of any concern unless there was to be the addition of supplementary grain, which would increase dietary Phosphorous intake and necessitate the addition of a calcium supplement.

The nitrogen to sulphur balance was low for the no tillage (7.2:1, plot 1), and high for plots 5,6, 7 and 9. This high ratio is driven by proportionally low sulphur compared to moderate to high protein level in the pasture. Sulphur can be supplemented to livestock easily in the form of a loose lick mineral or mineral block as many commercial products deliver trace minerals in sulphate form. Longer term assessment and adjustment of the soil sulphur status may increase pasture concentrations and remove the need for direct supplementation of the animal.

Table 2: Forage mineral parameters at Booderoo in 2022

Treatment	Calcium	Potassium	Magnesium	Sodium	Phosphorus	Sulphur	Grass Tetany Index	Ca:P	N:S
BOODEROO									
Control (no tillage)	4767	11667	1333	1057	2600	1153	2.0	1.8	15.6
Control + manure	6000	12000	1500	660	3200	2000	1.6	1.9	7.2
Bednar + mix	4100	16000	1500	640	3200	1600	2.9	1.3	11.1
Bednar + mix + manure	4400	15000	1300	500	3000	1400	2.6	1.5	11.2
Plozza plow	3000	11000	1200	660	3100	1100	2.6	1.0	18.9
Plozza plow + manure	5100	22000	1500	1500	3500	1100	3.3	1.5	15.4
Bednar rip	8600	19000	2200	930	3500	1500	1.8	2.5	13.3
Bednar rip + manure	6500	15000	1700	620	3000	1200	1.8	2.2	16.7

2.3 Gross margin potential

A summary of grazing duration and predicted DSE rating is summarised in Table 3. These figures were then included in a GM assessment along with the standing biomass and its DSE rating.

Table 3: Grazing records at Booderoo in 2022

Stock Class	Grazing Start	Grazing Finish	# head	Area (ha)	DSE rating	TOTAL DSE
BOODEROO						
900 Merino ewes with Lambs at foot	11/8/22	12/8/22	900	4.5	3.5	3150

The predicted Gross Margin/ha/year for the control was $256.81; all treatments provided an increased GM above the control, except for the control + manure ($14.96 lower; Table 4). The greatest increase in predicted GM observed was $234.96/ha above the control for the Bednar+ mix+ manure treatment. All tillage treatments added $60-76/ha, whereas the addition of the manure provided an average $148 increase in GM.

Table 4: Predicted total Gross Margin potential for treatments at Booderoo in 2022. Data based on biomass, ME value and actual grazing records.

Treatment	Predicted total DSE days inc grazing removal	Gross Margin Value/DSE ($)	TOTAL GM/Ha/Yr	TOTAL GM CHANGE/Ha/Yr
BOODEROO				
Control (no tillage)	6489.4	65	$256.81	
Control + manure	6111.3	65	$241.85	-$14.96
Bednar + mix	8020.5	65	$317.40	$60.59
Bednar + mix + manure	12426.8	65	$491.77	$234.96
Plozza plow	8411.8	65	$332.89	$76.08
Plozza plow + manure	11741.3	65	$464.65	$207.84
Bednar rip	8011.2	65	$317.03	$60.22
Bednar rip + manure	11473.9	65	$454.07	$197.26

3. Discussion

3.1 Forage quality parameters

Before discussion of the quality parameters measured herein, it must be noted that the primary initial goal of this case study was to understand soil amelioration strategies and their effect on the ability to grow biomass. As such, the measurements of biomass and feed quality did not necessarily align with optimal grazing times, nor reflect the exact time at which animals were grazing. When assessing any of the measured feed quality and biomass parameters this caveat must be kept in mind.

Based on the November forage harvest and quality assessment, all treatments had insufficient energy density or digestibility to maintain the requirements of the stock grazing them, or the simulated 60kg ewe and 500kg cow. The November measurement period is quite late in the growing season for these locations, and as such the forage is expected to have matured and reduced in quality. In a practical scenario when faced with a large standing biomass of forage with reduced quality, it would be recommended to implement supplementary feeding with grain, pellets and an additional source of protein to assist in meeting energy requirements and to assist in digesting the higher NDF forage available.

3.2 Forage mineral parameters

Grass Tetany, also known as grass staggers or hypomagnesemia, is a metabolic disorder that occurs when ruminants consume forages that are low in magnesium (Mg), or have a high level of potassium. Grass tetany typically occurs in spring and autumn when animals are grazing lush, rapidly growing grasses that have low magnesium content and high potassium (K) levels. Liberal use of potassium fertilisers also increase the risk of grass tetany irrespective of the season or inherent soil and pasture levels of magnesium. To assess the risk of grass tetany in ruminants, a parameter known as the Grass Tetany Index (GTI) is sometimes used. The GTI is a calculation based on the ratio of potassium to calcium and magnesium in the forage. The formula for calculating the GTI is as follows:

$$GTI = K\ \% \div (Mg\ \% + Ca\ \%)$$

The GTI provides an indication of the potential risk of grass tetany. Generally, a GTI value greater than 2.2 is considered to be a high risk, while values between 1.5 and 2.2 indicate a moderate risk and other factors such as animal age, breed, stage of production, weather conditions, should also be considered when evaluating the risk.

Calcium and phosphorus both play a vital role in many physiological processes, including bone development, nerve and muscle function, and energy metabolism. Calcium and phosphorus deficiency can cause several health problems in ruminants, including poor growth, weak bones, and reproductive issues. Excessive intake of these minerals can lead to mineral imbalances and toxicity, which can also cause health issues.

In ruminants, calcium and phosphorus are primarily obtained from the diet, and the balance between these two minerals is important for maintaining the above functions. The ratio of calcium to phosphorus in the diet should ideally be between 1:1 and 2:1 for ruminants, depending on the stage of production. Calcium and phosphorus absorption and utilization in ruminants are complex processes and are influenced by several factors, including dietary intake, gut pH, and the presence of other minerals in the diet, such as magnesium and vitamin D.

The ratio of nitrogen to sulphur is also an important consideration in ruminant nutrition because it affects the rumen microbial population, the ability to digest feed and the overall efficiency of nutrient utilization by the animal. The ideal nitrogen to sulphur ratio in the rumen is generally considered to be in the range of 10:1 to 15:1. Maintaining this balance is crucial for optimal rumen function and microbial activity. If the nitrogen to sulphur ratio is too low, microbial growth in the rumen is limited, leading to reduced fibre digestion and decreased feed efficiency. On the other hand, if the relative ratio of nitrogen is too high (sulphur-deficient), it can result in excessive ammonia production in the rumen, which reduces rumen microbe activity, decreases rumen pH and puts animals at risk of neurological and hepatic damage should the excess ammonia enter the bloodstream. Overall, maintaining a balanced nitrogen to sulfur ratio in the rumen is essential for promoting optimal rumen function, microbial activity, and nutrient utilization in ruminant animals.

Higher potassium levels, or lower calcium levels were the cause of higher GTI at Booderoo. There is potential that the addition of manures and composts may lead to a spike in available potassium, and as such the risk of greater plant concentrations and resulting animal intake exists. Managing potassium is a fickle balance, as application can drive plant growth, but lead to nutritional issues in ruminants. Low calcium levels in the forage can be addressed through the application of lime or foliar calcium products. To prevent grass tetany, it is common practice to provide magnesium and calcium supplementation to animals at risk. This can be achieved through loose lick mineral supplements, feed additives, or magnesium boluses for cattle.

The addition of composts and manures can also lead to spikes in phosphorous, which may exacerbate imbalances in other minerals, particularly calcium. Inherently low calcium levels can skew ratios further out of balance. Appropriate testing of the soil, product to be applied and the forage grown will give the greatest insight into how to most cost effectively treat the imbalance.

When grazing high NDF, low protein pastures, balancing the N:S ratio will ensure that the lower digestibility feed is adequately utilised, and animals can optimise protein utilisation. Overall, there were few pastures that required this to be addressed at the November time point. Should these pastures have been grazed for longer into the season these ratios would change and require supplementation with a source of nitrogen.

If pastures of this composition were to be grazed again for extended periods of time, then it is recommended that a nutritionist be consulted to develop an appropriate supplementation strategy for the class of livestock to be used, particularly addressing the mineral requirements. A simple solution of a loose lick mineral will likely address all of the imbalances observed herein and allow animals to utilise the additional biomass.

The predicted Gross Margin figures were based purely on the biomass grown and its energy content. It must be noted that the calculations assumed 100% utilisation of grown biomass measured, which is higher than conventionally achieved. Being driven by biomass yield, the treatments with the greatest increase in forage growth exhibited the greatest GM figures.

This case study has demonstrated significant increases in biomass yield can be achieved through soil amelioration and nutrition strategies on non-wetting sands. As always, the needs and relative balance between soil-plant-animal need to be considered when addressing amelioration and fertiliser strategies to allow for any additional biomass to be utilised and the maximum value captured by the producer.

Project Summary

Improved knowledge and health of non wetting soils delivering sustainable and productive soil management decisions based on evidence

FUNDED BY THE NATIONAL LANDCARE PROGRAM

PROJECT SUMMARY

The project has been developed to optimise soil health and water use on sandy grazing country across the Coorong and Tatiara District Council regions. This project will demonstrate new and emerging technologies to build producer confidence to try new techniques, improve soil health and groundcover, increase production and reduce ground water recharge across the region.

Image 2. Increasing perennial veldt pasture production, Meningie East. (Photo credit. F. Turner)

PROJECT AIM

To improve the knowledge and skills of farmers in dealing with non wetting sands, understanding soil limitations, the options available to address the water repellence issues when establishing crops and pastures, and how to maximise production in existing pasture systems.

Image 1. Imants spader incorporating clay to overcome water repellence, Western Flat. (Photo credit, M. Fraser)

KEY PROJECT ACTIVITIES

Novel and conventional management techniques will be demonstrated in annual and perennial based systems on sandy soils with the aim of optimising production, maximising water use and improving soil health.

Demonstration sites will be established to address one of the following key issues

- Water repellence in sands
- Maximising pasture production in perennial based systems

These demonstration sites will be monitored over a two year period and supported with crop walks, workshops, technical updates and a web based platform.

ADDITIONAL ACTIVITIES

Installation of three automated soil moisture and water table monitoring systems and monitoring of an additional ten piezometers to capture changes in the water table and monitor dryland salinity trends.

COORONG DISTRICT COUNCIL Tatiara the good country Coorong Tatiara Local Action Plan Australian Government National Landcare Program

Increasing veldt production on sandy soils

BACKGROUND

Veldt grass over time has become dominant in the landscape across the Coorong and Tatiara District council regions.
As a pasture species that often regenerates naturally on sandy soils, little is known about its production potential and the agronomic practices that will maximise feed production - both quality and quantity.
Three demonstration sites were established in 2022 looking at different agronomic opportunities to try and increase production.

TREATMENT LOCATIONS

Menalpyn - The role of Giberllic acid mixes in increasing veldt production

Jacobs Well - Exploring the soil nutrition requirements of veldt pasture

Cavanagh Farms - Can foliar treatments assist in increasing veldt production

Image 1. Location of Veldt treatment sites

Image 2. Veldt flowering in Spring, Field

ACTIVITIES AT EACH SITE

Each site was soil tested prior to the treatment being applied to understand the initial soil fertility levels.
Soil tests were taken from the 0-10cm layer (surface sampling) and the 10-30cm layer to look at soil fertility levels through the profile.
A combination of sampling techniques was utilised;

- Zone sampling (field was split into 3 soil zones based on historic imagery layers)
- Grid sampling (field was sampled on a 1ha grid to assess field variability)
- Representative path sampling (area was sampled on a path across the treatment area which was relatively consistent.

The demonstration strips were then applied across the paddock with biomass cuts taken to assess variation across treatments at a given time after application.

This project is supported by the Coorong and Tatiara District Councils through funding from the Australian Government's National Landcare Program

"Menalpyn"

THE ROLE OF GIBERELLIC ACID MIXES IN INCREASING PASTURE PRODUCTION

BACKGROUND

The Cartledge family have been farming Menalpyn since it was cleared. Over that time pasture mixes have changed, but veldt grass has become an integral part of their pasture along with lucerne on which they graze their cattle.
Two years ago, they sprayed some strips of giberellic acid (GA) and other products across some veldt pastures to see if they could improve their winter feed production. The initial results were encouraging, so a more formal demonstration was established to quantify these responses and see if they were repeatable.

SOIL FERTILITY SNAPSHOT

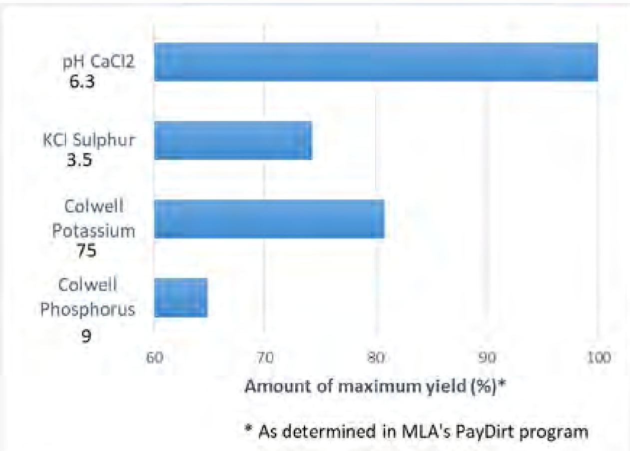

Figure 1. Average soil test results (0-10cm)

SITE ACTIVITIES

The site was soil tested on a zone basis to see how the site varied across different production zones. The average results (across 4 zones) are those presented in Figure 1.
Foliar treatments were then applied (2 different timings) and plant biomass measured prior to grazing.

Figure2. Visual response to treatment (RHS)

Tmt 1: Untreated Control
Tmt 2: SOA Applied 24/5/22 + Giberellic acid, UAN, Manganese, Copper, Zinc and Fulvic acid applied on 23/6/22.
Tmt 3: SOA Applied 24/5/22

RESULTS

Pasture assessments were conducted on 26/7/2022 to measure differences between treatments. They show a large increase in biomass production on low fertility soil in that critical winter period when feed is often lacking. (Control = 740 kg DM/ha)

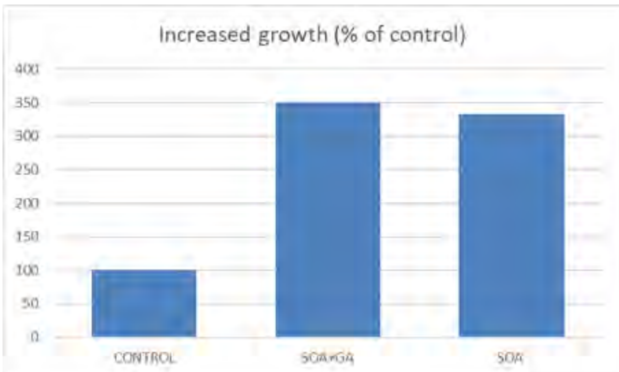

Figure 3. Biomass responses to treatments

Later applications (end of July) of the GA mix resulted in an increase in production but it wasn't as great as the earlier timing.

COORONG District Council
Tatiara the good country
Coorong Tatiara Local Action Plan
Australian Government
National Landcare Program

Thanks to the Cartledge family at Menalpyn for hosting this demonstration

Cavanagh Farms

CAN FOLIAR TREATMENTS ASSIST IN INCREASING VELDT PRODUCTION?

BACKGROUND

With the observations being made at Menalpyn in 2021, farmers were keen to see if these results could be replicated in other areas, so a demonstration site was established at Mount Charles looking at the use of Giberellic Acid (GA) as a stand alone product compared with other foliar treatments to see if they could be cost-effective solutions to increasing veldt production on sandy soils.

SOIL FERTILITY SNAPSHOT

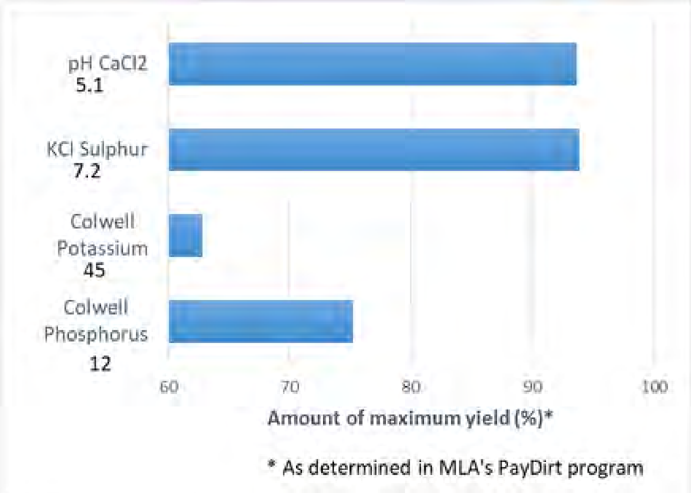

Figure 1. Soil Test results (0-10cm)

SITE ACTIVITIES

Soil Tests were taken on a transect across the site area as a representative sample.
All treatments were applied on 18/7/22 by boomspray with a control strip between each treatment for comparison.
Treatment 1: Giberellic Acid
Treatment 2: Amino Boost Max
Treatment 3: Momentum ZnP
Pasture cuts were taken approximately 6 weeks later on 28/8/22 with dry matter production and feed test data collected.

Figure 2. Site photo taken prior to sampling; GA treatment in foreground

RESULTS

Pasture assessments were taken and a sub-sample sent away for Feed Test analysis.
The Giberellic Acid provided the greatest increase in biomass production (Figure 3), however the quality of the feed was reduced - particularly when compared to the Amino Boost Max (Figure 4).
The control production measured was 1300kg DM/ha on the 28/8/22.

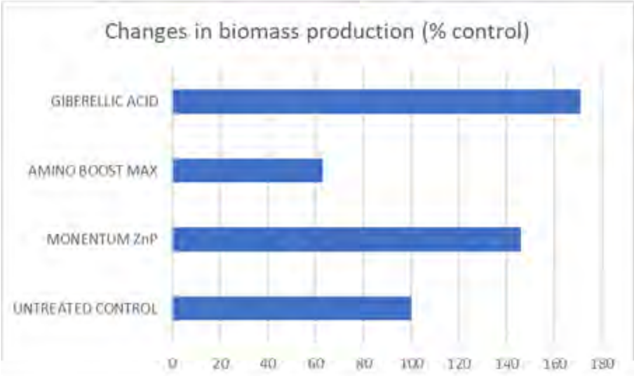

Figure 3. Changes in biomass production as a % of the untreated control

	CONTROL	Momentum ZnP	Amino Boost Max	Giberellic Acid
Dry Matter (%)	49.3	51.3	37.1	35.9
Crude Protein (%)	5.6	4.2	9.9	7.1
NDF (%)	72.4	76.1	66.5	73.2
DMD (%)	46.5	44.5	53.4	49.9
Est.ME (MJ/kg DM)	6.4	6	7.6	7

Figure 4. Differences in key feed quality factors between treatments

Thanks to the Allen / Cavanagh families for hosting this demonstration

"Jacobs Well"

EXPLORING THE SOIL NUTRITIONAL REQUIREMENTS OF VELDT GRASS

BACKGROUND

For a grass species that dominates the landscape in the Coorong and Tatiara regions, not a lot is known about the nutritional requirements of Veldt Grass and the impact on varying soil fertility levels on production.
The demonstration at Jacobs Well is exploring this over a 2 year period to see if the production response curve of Veldt is similar to that of other temperate perennial grasses.

SOIL FERTILITY SNAPSHOT

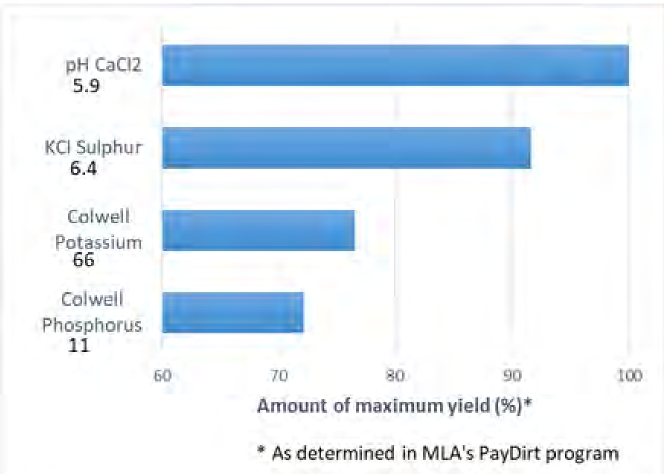

Figure 1. Average soil survey results (0-10cm)

SITE ACTIVITIES

The site was soil tested on a grid basis to determine nutrient variability across the site. Figures 2a-b shows the variability of key soil properties across the site.
Nutrient applications were then targeted to aim for 70%, 80% and 95% production levels as determined by MLA's PayDirt Program.
Phosporous and Potassium were then applied to target levels separately through a variable rate spreader.

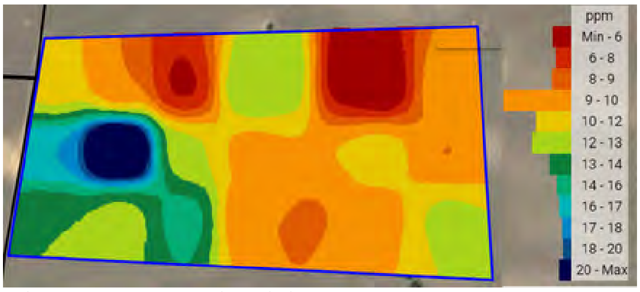

Figure 2a. Variability of Colwell phosphorous (P) (0-10cms)

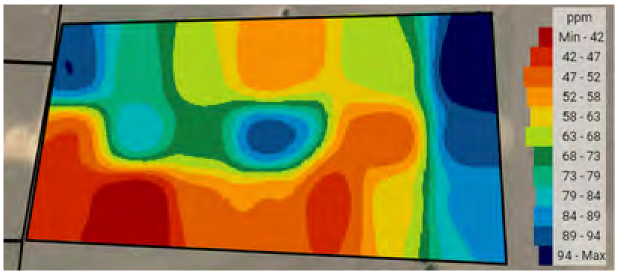

Figure 2b. Variability of Colwell potassium (K) (0-10cms)

RESULTS

The site was grazed over the winter and spring period and visual observations made with a noticeable change in pasture composition observed where the higher nutrient levels were applied (higher clover content).

In 2023, the spring growth 4 weeks post-grazing was measured (22/9/23) with the results shown below in Figure 3. This suggests that veldt grass may be nutrient responsive and that there is the capacity to increase production through fertiliser applications.

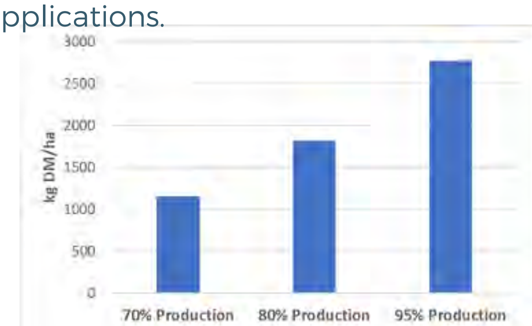

Figure 3. 2023 Spring Dry Matter results across fertiliser target production levels

Thanks to Mark Turner for hosting this demonstration

Deep Ripping + Inclusion Plates Demonstration

FUNDED BY THE NATIONAL LANDCARE PROGRAM

BACKGROUND

A paddock at Sherlock was deep ripped in 2022 to overcome high soil strength and dilute severe water repellence at the surface. A 6m wide Agrowplow SLTAP91 deep ripper with inclusion plates fitted was used to funnel the topsoil into the subsoil behind the shank, with the aim of de-compacting the profile to >50cm.

Image 1. Agrowplow Deep Ripper with inclusion plates fitted on the outside shanks.

TREATMENTS

1) No-tillage Control
2) Deep Rip + Inclusion Plates
Two seeding configurations were tested: direct seeding; and direct seeding + additional seed broadcast to achieve zero row spacing.

RESULTS

Soil strength was measured using a digital penetrometer. Penetration resistance (PR) exceeded the critical threshold of 2,500 kPa at 17cm in the Control (Figure 1); deep ripping reduced the PR below this threshold to a depth of 45cm.

Deep ripping increased barley grain yield by 0.16 t/ha above the Control (1.46 t/ha, Figure 2), and was further improved with zero row spacing (+ 0.32 t/ha).

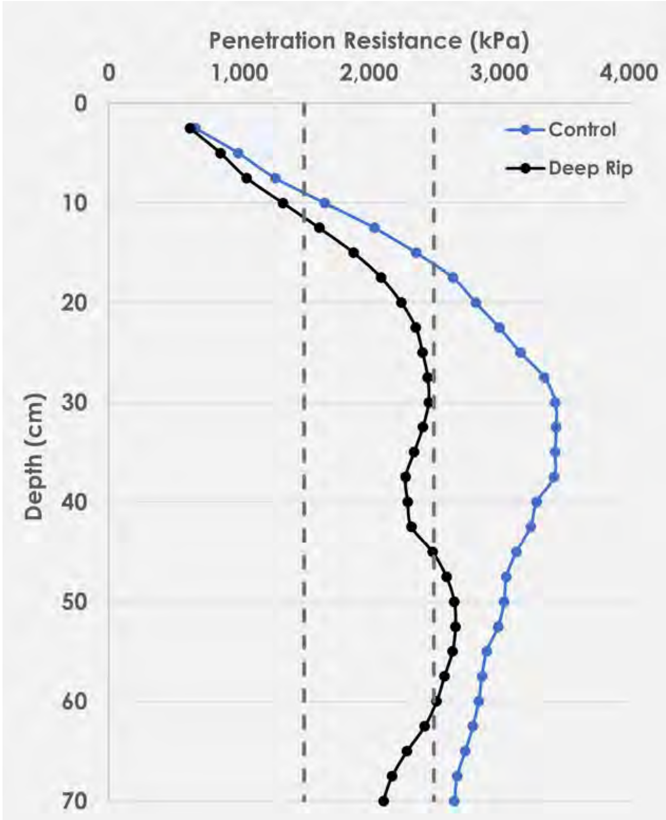

Figure 1. Soil penetration resistance (kPa), showing deep ripping causes a substantial reduction in soil strength.

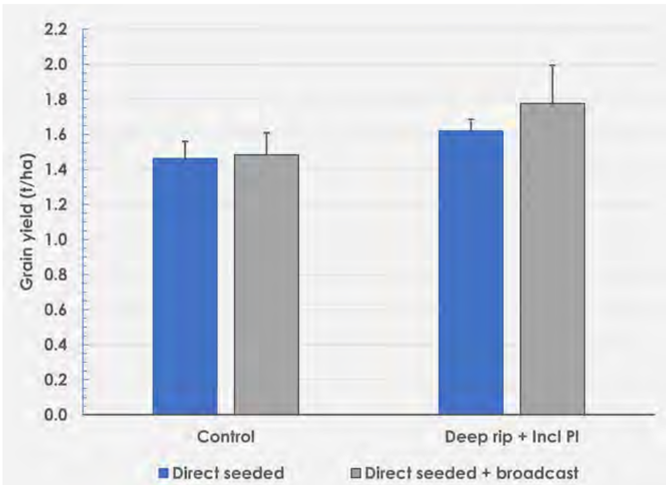

Figure 2. Barley grain yield results in 2022 in response to deep ripping with direct sowing +/- additional broadcast seed to achieve zero-row spacing.

Many thanks to David Peter for hosting this demonstration at Sherlock, SA.

Coorong Tatiara Local Action Plan
Australian Government
National Landcare Program

Spading & Deep Ripping Demonstration

FUNDED BY THE NATIONAL LANDCARE PROGRAM

BACKGROUND

A paddock at Western Flat was spread with 250 t/ha of clay that was incorporated in the top 15cm, overcoming water repellence. Two strips of 500 t/ha were applied and an Imants Spader + Deep Ripper was used to test clay incorporation and decompaction when operated at different ripping and mixing depths.

Image 2. Treatments were applied to plots 10.5m wide, as seen here on the left.

TREATMENTS

1) No-tillage Control
2) Rip 30cm and Spade 10cm
3) Rip 40cm and Spade 30cm

RESULTS

Soil strength was measured in August 2022 using a digital penetrometer. Penetration resistance exceeded the critical threshold of 2,500 kPa at 35cm in the Control, and was substantially improved by ripping to 40cm and spading to 30cm (Figure 1).

Image 1. Imants spader with deep rip tines for enhanced deep tillage.

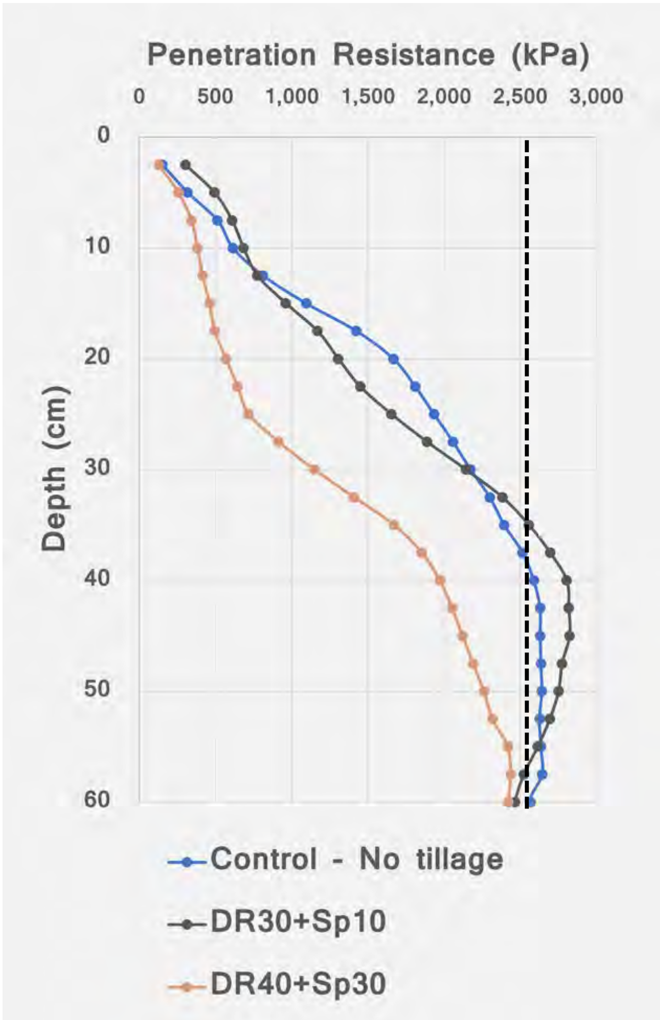

Figure 1. Deep ripping and spading reduced soil strength after clay spreading.

Many thanks to Hamish Verco for hosting this trial at Wee-Gun, Western Flat, SA.

Improving Production on Non-Wetting Sands – Event Evaluation

Coomandook workshop and farm visit – Thursday 28 September 2023

Scan this QR code on your smart phone

and complete the survey

OR turn the page and complete the paper version and leave with Tracey

Thankyou!

Improving Production on Non-Wetting Sands – Event Evaluation

Coomandook workshop and farm visit – Thursday 28 September 2023

ROLE: *Please circle*

Landholder	Adviser/Agronomist	Industry	Other

HOW MANY HECTARES DO YOU MANAGE? ……………………………………………………….

Mixed Farming	Cropping only	Sheep only
Cattle only	Dairy enterprise	Other

HOW MANY SHEEP DO YOU RUN? ……………………………………………………………………………….

HOW MANY CATTLE DO YOU RUN? ……………………………………………………………………………..

1. **How would you rate your satisfaction with today's session:**
   (1- poor satisfaction, 10 - excellent satisfaction)

1	2	3	4	5	6	7	8	9	10

2. **Please rate the value of today's session out of 10 for you and your business:**
   (1- poor value, 10-excellent value)

1	2	3	4	5	6	7	8	9	10

3. **Has today's event increased your knowledge in the following areas (Yes or No)**
   Please circle

Understanding soil biology and its role in soil health.	Y	N
Understanding the impact of soil amelioration on fodder production and feed quality parameters.	Y	N
Strategies to improve ***existing/established*** pasture production on sandy soils.	Y	N
Strategies to treat sandy soil constraints to boost crop and pasture production.	Y	N

4. **Intent to change:**

In regard to what you learnt about ***soil biology*** are you likely to make any business / on-ground changes on your farm?	No	Unsure/ Maybe	Likely	Definitely
In regard to what you learnt about ***feed volume and quality after amelioration*** are you likely to make any business / on-ground changes on your farm?	No	Unsure/ Maybe	Likely	Definitely
In regard to what you learnt about ***strategies to boost the production of existing pastures*** are you likely to make any business / on-ground changes on your farm?	No	Unsure/ Maybe	Likely	Definitely
In regard to what you learnt about ***deep tillage and compost use to boost crop and pasture growth*** are you likely to make any business / on-ground changes on your farm?	No	Unsure/ Maybe	Likely	Definitely