IMPROVED GRAZING PRODUCTION ON NON-WETTING SANDS

COMPOST RATE CASE STUDY

This case study explores how compost application affects soil fertility and biomass production after clay spreading.

AT A GLANCE

Challenges

Sandy soils are naturally low in organic carbon and are deficient in most essential plant nutrients.

Opportunities

Clay spreading can overcome multiple sandy soil constraints, but the process is very disruptive. It's important to support the soil to quickly recover its chemical, physical and biological function.

I knew this paddock would be low in nutrients and organic matter after clay spreading. I was keen to explore different ways to supply these, while also supporting soil microbes. This trial lets us test compost application rates and measure changes in feed production over time.

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Owner Manager, Wee-Gun Western Flat

BACKGROUND

A 15ha pasture paddock at Western Flat, SA, was selected to demonstrate strategies to restore soil function following clay application and incorporation. The paddock is characterised by jumbled dunes with deep sandy soils (Image 1) and sporadic heavier flats.

Soil sampling in 2021 confirmed the sand dunes to be severely water repellent and deficient in phosphorus and potassium, with organic carbon below 1%. It has low capacity for nutrient retention throughout (cation exchange capacity <1.0 cmol/kg below 10cm), but did not have high soil strength.

Clay spreading is common practice to alleviate water repellence and 250 t/ha of clay material was applied across the paddock in early 2022, before being incorporated with a disc plough in autumn (Image 2).

A survey with local farmers in 2021 showed 65% were interested in testing multispecies pastures and over 70% wanted to see organic amendments demonstrated in their environment.

In May 2022, compost treatments were applied on plots 1.1 ha in size to boost biological function and nutrient supply using a custom blended compost.

Four different compost rates are tested against a fertiliser control (Images 3-7).

The paddock was sown to multispecies pastures in 2022 and 2023 and has been monitored annually. The demonstration is in its final year of monitoring in 2024.

Image 1. Soil profile from the deep sand dune prior to clay and compost being applied.

TREATMENT DETAILS

1) Custom Fertiliser: a blend of mono-ammonium phosphate, sulphate of potash, copper and molybdenum ($1873/t ex Naracoorte; GST Incl.) was spread at 160 kg/ha to supply 11N, 24P, 20K, 9S, 1Cu and 0.04Mo kg/ha ($299/ha + $41/ha spreading cost).

2) Custom Compost: an organically certified humic compost was supplied locally from Mulbarton Compost at Padthaway at a cost of $174/t (GST Incl.) delivered and spread. 29 kg of Guano, an organic phosphorus fertiliser (12.6% P), was blended into each tonne of compost prior to application. Nutrient supply (kg/ha) for each compost rate (t/ha) is shown below.

Rate t/ha	N	P	K	S	Ca
1	11	3.6	10	1.6	44
2	22	7.2	20	3.3	88
4	44	14.4	40	6.6	176
8	88	29	80	13.2	352

Image 2. Aggregates of clay mixed into sand.

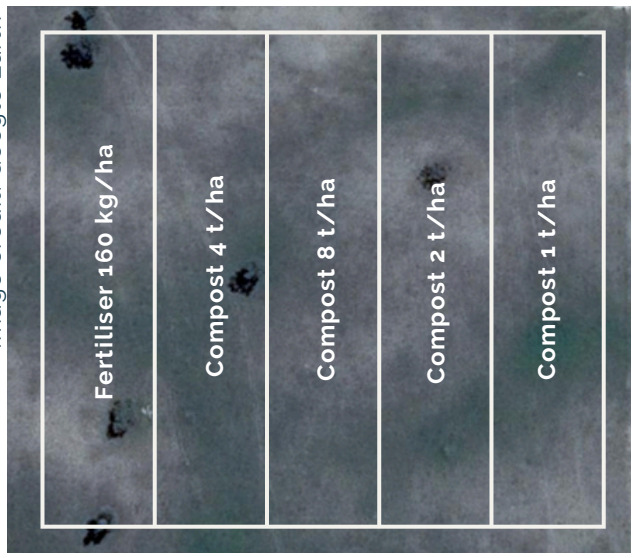

Image credit: Google Earth

Image 3. Trial map (5 treatments x 1.1ha).

Image 4. Compost applied @1 t/ha.

Image 5. Compost applied @2 t/ha

Image 6. Compost applied @4 t/ha.

Image 7. Compost applied @8 t/ha.

Measurements: Normalised difference vegetation index was measured annually using a Trimble Greenseeker by recording 5 transects across the dune crest in each plot.

In 2022 and 2024, dry matter was assessed by harvesting 0.5m2 quadrats to ground level in 12 and 9 locations respectively per treatment. In 2023, a rising plate meter was used, recording 15 dry matter measures across three transects in each plot, calibrated with pastrue cuts. Composite subsamples were retained for moisture and quality assessment.

Image 8. Fertiliser 160 kg/ha - NDVI 0.39

Image 9. Compost 1 t/ha - NDVI 0.30

Image 10. Compost 8 t/ha - NDVI 0.28

YEAR 1 RESULTS

A mixed species pasture was sown on 15 May 2022, comprised of Balansa, Arrowleaf and Rose clovers, Paraggio medic, vetch, Blast ryegrass, Saia oats, ryecorn, and tillage radish at a rate of 69 kg/ha ($108/ha).

The seed was sown with 130 kg/ha of SMS Guano (12% P) after being treated with a fluid bio-stimulant comprised of compost extract, worm extract, seaweed powder, milk powder, molasses, humic powder, fish hydolysate, wood vinegar, mycorrhizal fungi and N fixing bacteria. The brew was applied to the seed through an auger and allowed to dry prior to planting. The paddock was sown following the hill contours to encourage water infiltration and reduce rill erosion.

Normalised difference vegetation index (NDVI) results showed enhanced growth in the Fertiliser treatment in July. By September, the 2 and 8 t/ha compost treatments were as good as or better than the Fertiliser treatment, as confirmed by dry matter yield (Table 1).

Table 1. 2022 plant production measures: Normalised difference vegetation index (NDVI) in July and September; dry matter yield (DM t/ha) in September, prior to grazing; 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	NDVI Sept	DM t/ha September	DM t/ha November	DMD %	CP %	ME MJ/kg
Fertiliser 160 kg/ha	0.39 a	0.69 b	0.67 a	2.77 a	58.7	12.7	8.5
Compost 1/ha	0.30 b	0.60 c	0.38 b	2.04 c	60.1	11.7	8.7
Compost 2 t/ha	0.28 b	0.77 a	0.55 a	2.59 ab	59.6	13.2	8.6
Compost 4 t/ha	0.29 b	0.60 c	0.40 b	2.42 b	60.6	13.6	8.8
Compost 8 t/ha	0.28 b	0.72 ab	0.57 a	2.48 ab	56.9	16.1	8.2
LSD (p=0.05)	0.042	0.046	0.14	0.34	-	-	-

YEAR 1 RESULTS

Winter pasture growth was slow in 2022, owing to continuous cool and cloudy conditions, hence less than a ton of **dry matter** (DM) had grown by September (Table 1). The paddock was grazed in mid September and recovered well through a relatively cool and wet spring.

The Fertiliser, 2 t/ha and 8 t/ha Compost treatments were the best and most consistent performing, producing >0.55 t/ha DM in September and >2.45 t/ha in November.

These higher yielding treatments had lower dry matter digestibility than the 1 and 4 t/ha Compost rates, but crude protein was considerably higher in the 8 t/ha treatment (data not replicated).

Pasture composition and maturity showed some differences between treatments, with the Compost treatments supporting greater legume composition that was still actively growing in November (see Images 11-13); the Fertiliser treatment was beginning to senesce.

Image 11. Fertiliser - 2.77 t/ha (2022)

Image 12. Compost 2 t/ha - 2.59 t/ha

Image 13. Compost 8 t/ha - 2.48 t/ha

YEAR 2 RESULTS

The paddock was sown to a multispecies fodder crop on 15 April, composed of Saia oats, ryecorn, triticale, Blast ryegrass, Crimson, Rose, Arrowleaf and Balansa clovers, vetch, tillage radish, buckwheat, chicory, plantain, cocksfoot, lucerne and phacelia (totaling 51.4 kg/ha). A blend of compost + 14 kg/t of guano was spread on 17 April at approximately 1.07 t/ha.

Unfortunately, Veldt grass germinated across the paddock in 2023, competing heavily with the sown pasture, with no post-sowing herbicide options available for control. Establishment of the desirable pasture species was substantially impacted as a result (Images 14-15).

Nonetheless, **Dry matter** yields largely followed the same trend as in 2022, whereby the treatment with custom fertiliser applied yielded the highest DM (cumulative 1 t/ha more than the 1 t/ha compost treatment; Figure 1). In 2023 the 8 t/ha compost treatment was the next best performer, adding 0.94 t of DM above the 1 t/ha treatment; it also had better forage quality (data not shown).

Assessments of soil structure were conducted in October, following poor pasture recovery after the September grazing. Surface soils were found to be very compacted, owing to a thick surface layer of dispersed/pugged clay. Areas with better incorporation supported greater pasture diversity and biomass (Images 16-17).

Image 14. Fertiliser - 2.19 t/ha (2023)

Image 15. Compost 4 t/ha - 2.05 t /ha

YEAR 2 RESULTS

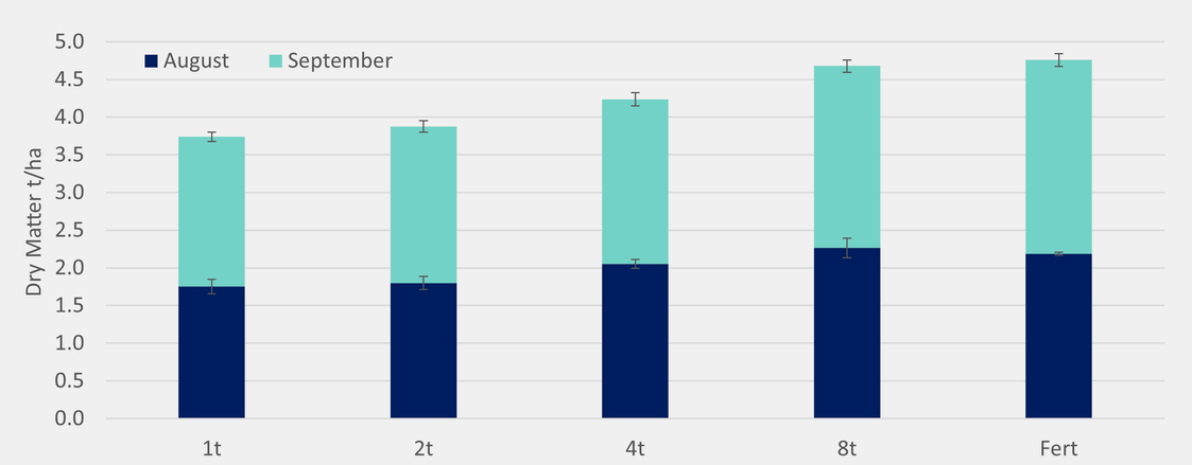

Figure 1. Cumulative pasture dry matter yield (t/ha) at Wee Gun measured in August and September 2023.

Image 16. Poor clay/pasture.

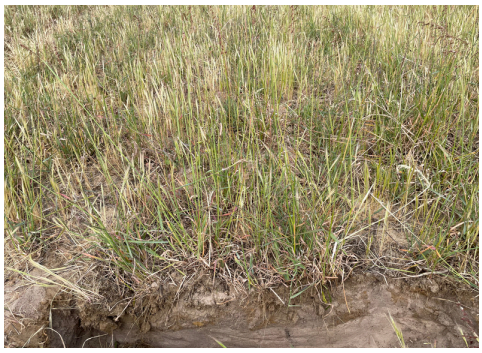

Image 17. Good clay/pasture.

YEAR 3 RESULTS

The observed loss of soil structure and poor pasture growth in 2023 motivated Hamish to better incorporate the thick surface clay in 2024.

In April, an Imants spader was used to loosen the soil (via the deep ripping tynes; Image 18) and mix the surface and subsurface layers of sand and clay. Mixing the layers led to better dilution and deeper placement of clay. The impact of the spader was evident to 35cm (Images 19 and 20).

Image 18. Imants Deep Rip + Spader

Image 19. Non-spaded soil, showing a thick band of clay concentrated in the top 15cm.

Image 20. Soil profile after spading, showing substantive mixing of the clay A1 and sandy A2 horizons beyond 30cm.

YEAR 3 RESULTS

The paddock was subsequently sown to a multispecies crop of Saia oats, winter and grazing brassica, vetch and tillage radish in May. The very late winter break delayed germination of the pasture, with plants at only 2-3 leaf stage in mid-July.

Dry matter was measured on 3 September, prior to grazing. Ordinarily a second DM assessment would be conducted, but the pasture did not recover due to drought conditions and was subsequently spray-topped to freeze weed seeds in preparation for sowing a perennial pasture in 2025.

Nonetheless, **dry matter** measured in spring 2024 revealed lasting and substantive differences among treatments, even after spading earlier that year, which would have buried the amendments that were surface applied in 2022 and 2023.

For the first time ever, the 1t treatment achieved the highest yield, with an average DM of 490 kg/ha, followed by the Fert treatment with 460 kg/ha (Figure 2). The 2t, 4t and 8t treatments yielded moderately lower results, with mean DM yields of 331, 373 and 374 kg/ha, respectively.

The higher yield in the 1t/ha treatment was attributed to a high proportion of tillage radish in that zone that had produced both large tubers that grew above the soil surface and thick flowering stems, as seen in Image 19.

It was pleasing to see the site recover in 2024 despite dry conditions, proving that the spading was necessary to incorporate surface clay and improve soil air and water infiltration.

At Wee Gun the **cumulative DM** measured in spring 2022, 2023 and 2024 shows yields increasing in line with each compost application rate, and that the Fertiliser treatment was the most productive with >8t/ha cumulative DM measured (Figure 3).

Overall, the three-year trial at Western Flat demonstrates that strategic combinations of clay spreading, fertiliser or compost application and improved clay incorporation can meaningfully enhance soil fertility, pasture composition and dry matter production on water repellent sands.

These results provide producers with practical, evidence-based options for restoring productivity on challenging sandy soils and lay a strong foundation for continued innovation in soil amendment strategies.

Figure 2. Pasture dry matter (kg/ha) in September 2024.

Image 21. 1t/ha compost 2024

Image 22. 8 t/ha compost

Image 23. Fertiliser

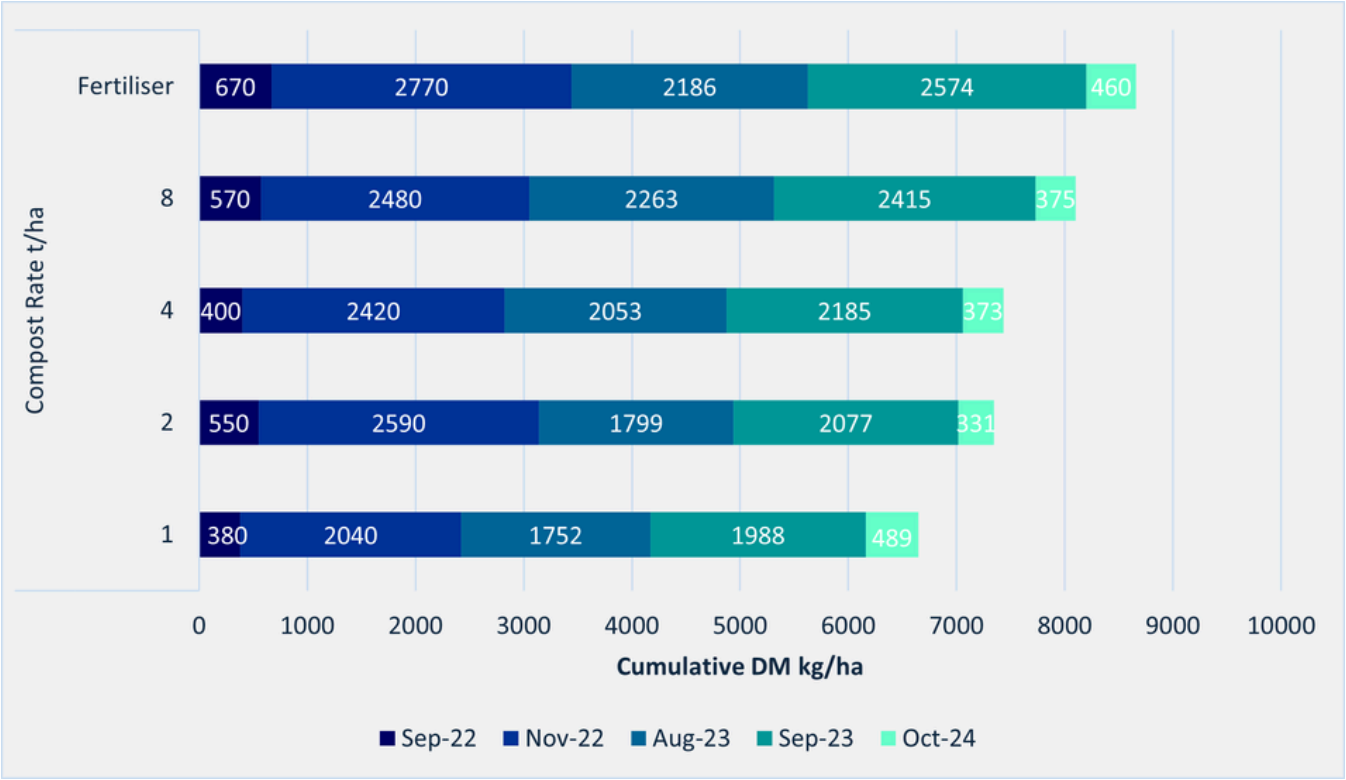

Figure 3. Cumulative pasture dry matter (kg/ha) measured in 2022, 2023 and 2024.

WHERE TO NEXT?

- Monitoring at this site is now complete.
- Head to www.ctprojectshub.au to learn about other related projects
- Head to www.soilhub.com.au to explore the Sandy Soils Constraints Calculator and Solutions Finder to explore treatment options to boost productivity on your own farm.

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