# 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.



## 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.



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# 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 (a) 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.

AGED MANURE



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



CHISEL PLOUGH





INVERSION

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.

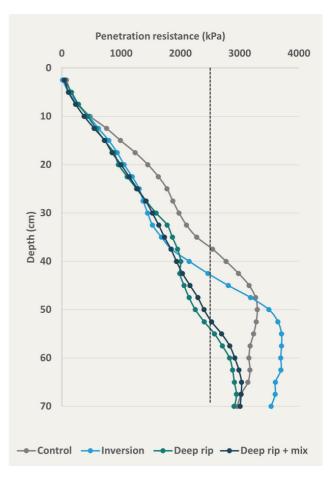


Figure 1. Penetration resistance (kPa) measured in 2022 for each deep tillage type.

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	-	-	-

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.

# 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).

## WHERE TO NEXT?



Deep rip + mix + manure - NDVI 0.49

- 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.

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