**Section Editor:**
**Fabio Arsego**
SARDI, Minnipa Agricultural Centre

# Ameliorating a deep repellent sand at Murlong in 2018 increased barley performance in 2019

**Nigel Wilhelm[1], David Davenport[2] and Mel Fraser[3]**

[1]SARDI, Waite Research Precinct; [2]Rural Solutions SA, Pt Lincoln; [3]Rural Solutions SA, Struan Research Centre, Naracoorte

**Location**
Murlong

**Rainfall**
Av. Annual: 385 mm
Av. GSR: 270 mm (May - Oct)
2019 Total: 223 mm
2019 GSR: 209 mm (May - Oct)

**Yield**
Water-limited yield potential: 4.2 t/ha barley
Long term average yield: 1.7 t/ha barley (yield gap = 2.5 t/ha)
Actual: 1.8 t/ha

**Paddock history**
2018: Razor CL wheat
2017: Scope CL barley
2016: Pasture
2015: Mace wheat

**Soil type**
Deep sand over clay
Soil profile: 0-5 cm water repellent, light brown/grey sand; 5-15 cm grey sand; 15-40 cm white sand; 40-70 cm yellow sand; 70-80 cm yellow light clay

**Plot size**
25 m x 2.3 m x 4 reps

**Trial design**
Experimental: randomised complete block

**Yield limiting factors**
Severe water repellence, low rainfall, frost.

## Key messages

- **Physically disrupting compacted layers down the profile of a repellent deep sand by ripping with inclusion plates or spading produced large performance gains in cereals over two years. Spading was the most effective but deep ripping was very cost-competitive.**
- **Deep ripping compared to spading creates less erosion risk but the ameliorated sand is still vulnerable.**
- **Five t/ha of incorporated lucerne pellets or high rates of fertiliser only increased grain yields in the first year and the gains were not profitable.**

## Why do the trial?

Previous research has shown that physical intervention on compacted sandy soils can deliver large yield increases. However, there is still a lot of uncertainty whether adding amendments to the intervention operation or thorough mixing/inverting of the topsoil is effective or profitable. The development of inclusion plates attached to deep ripping tines is a low-cost option for increased mixing of surface applied amendments and/or topsoil with less risk of soil erosion than spading or mouldboard ploughs. This trial aimed to:

- Determine if physical intervention and soil mixing improved yield on a sandy soil on eastern EP.
- Compare deep ripping with inclusion plates to spading.
- Identify if the addition of fertilisers or organic material provided additional benefits.

See the article in the EP Farming Systems Summary 2018 for more details of results from this trial in 2018 (“Ameliorating a deep repellent sand at Murlong increased wheat performance substantially in 2018,” p111).

## How was it done?

The trial is located on a broad sand dune running WNW-ESE at Murlong on eastern Eyre Peninsula and comprises 11 treatments by 4 replicates. Constraints at the site include severe water repellence, compaction (bulk density >1.7 at 12 cm), low organic carbon and poor nutrient fertility.

*Table 1. Trial establishment and cropping details for 2019 (trial was sown with Razor CL wheat in 2018)*

| | | |
|---|---|---|
| 19 April 2018 | OM and nutrient packages applied | • OM: Lucerne pellets at 5 t/ha<br>• Nutrient Package: nutrients applied to match lucerne - N 167, P 14, K 105, S 12, Cu 0.03, Zn 17, Mn 0.18 kg/ha. NPKS applied as granular and trace elements as fluids.<br>Treatments applied evenly across the surface on spaded plots or in bands to correspond with ripper tine spacings, immediately prior to spading and ripping. |
| | Soil treatments imposed | • Spading to 30 cm at 5 km/h<br>• Ripped: 4 tines at 64 cm spacings with inclusion plates, positioned 10 cm below the soil surface and operated at 5 km/h<br>• Shallow ripped (corresponding to the depth of spading) to 30 cm with 20 cm tall inclusion plates<br>• Deep ripped to 41 cm with 30 cm tall inclusion plates |
| 10 May 2019 | Sowing, inter-row on 2018 crop rows | 63 kg/ha Scope CL barley at 25.4 cm row spacing + DAP at 60 kg/ha (all treatments). In addition, urea at 55 kg/ha and SOA at 42 kg/ha were banded below seed rows for non OM and nutrient package treatments only. |
| 20 August 2019 | | Foliar spray of Zn, Mn and Cu.<br>No other nutrients during the season. |

Crop performance of an unmodified control is being compared to spading to 30 cm or ripping with inclusion plates (IP) to 2 depths (30 cm or 41 cm) with and without the addition of high rates of mineral fertiliser or lucerne pellets (Table 1).

Measurements taken include: Pre-seeding soil water and mineral nitrogen, crop establishment, biomass at flowering, yield, yield components and grain quality, and post-harvest soil water.

## What happened?

- In both years, severe water repellence resulted in low plant numbers where there was no soil disturbance treatment. Only a few barley plants/m$^2$ initially established in the unamended controls in 2019, the impact of water repellency being exacerbated by inter-row seeding and a pump breakdown which meant a wetting agent was not applied into the seed row as had been intended. Deep ripping improved crop establishment, but spading was the most effective treatment in both years. The addition of nutrients, or lucerne pellets, further improved crop establishment only in 2018. Ripping or spading from 2018 resulted in initial establishment of barley in 2019 of 35-46 plants/m$^2$.
- Crop growth in 2019 was very poor in unamended controls due to both low plant numbers and also due to poor vigour in the plants which had established. This is despite more N, P and S fertiliser having been applied to these plots at seeding (in both years). At flowering, controls only averaged 840 kg DM/ha while interventions varied between 2450 and 3920 kg DM/ha with spading having higher DM than ripping to 30 cm (ripping to 41 cm was intermediate between the two). Amendments had no consistent effect on barley DM.
- Flowering DM of wheat was increased by both physical interventions and amendments in 2018.
- The 2019 season at Murlong was poor with rainfall for the year up until harvest being just better than decile 1 and several frost events damaging barley yields. The controls averaged 720 kg/ha but yields after interventions in 2018 varied between 1250 and 1800 kg/ha (Figure 1). Spading and ripping to 41 cm resulted in the highest yields with ripping to 30 cm not quite as good. Neither amendment produced any grain yield increases in 2019.
- Wheat grain yields in 2018 were improved by ripping to 41 cm which was better than ripping to 30 cm. Spading yielded more than either ripping treatment and the addition of nutrients or lucerne further increased yield.
- Combined over the two years, ripping to 30 cm in 2018 has improved cereal yields from the control by 1100 kg/ha, ripping to 41 cm by 1800 kg/ha and spading by 2400 kg/ha. Incorporated lucerne hay or a multi-nutrient fertiliser package increased yields only in the first year (by about 300 kg/ha).

## What does this mean?

Physical interventions on this deep, water repellent sand at Murlong delivered large economic responses to cereals over the two years monitored so far. Even with deep ripping typically costing between $50 and $80/ha and spading at least double those costs, these physical interventions have already made a good return on their investment in the first two seasons following implementation. There are also good prospects for benefits continuing into at least a third season.

Spading has proven to be the most effective type of disturbance so far, but ripping to 40 cm with inclusion plates and wide rows (60 cm) is proving very competitive in terms of economic return.

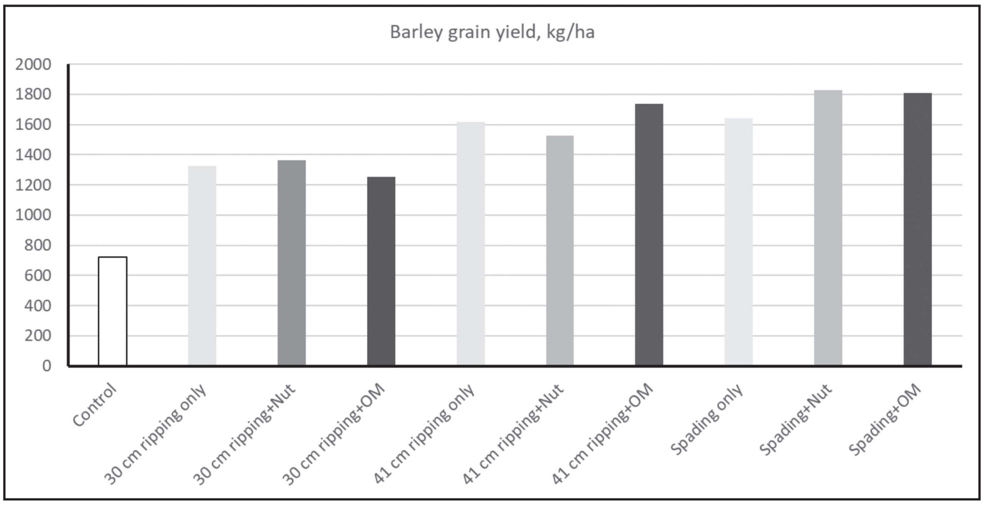


***Figure 1. Grain yield of barley (kg/ha) at Murlong 2019 (LSD, P=0.05, 260 kg/ha).***

Ripping has the additional benefit that it does not leave the ground as vulnerable to wind erosion as spading. Increased erosion is a factor with physically disturbing these fragile sands.

One of the reasons that interventions have produced better crops at this site is that they have improved early crop establishment despite severe water repellency. Spading is more effective than ripping in this aspect. However, seeder strategy trials conducted by the University of SA (see their articles in this edition and in the Eyre Peninsula Farming Systems Summary 2018) have shown that there are low cost options at seeding which can substantially improve early crop establishment on this severely repellent sand. A combination of those approaches with deep ripping could improve outcomes even further.

While incorporating lucerne hay or a multi-nutrient fertiliser package increased crop performance in 2018, the cost of these amendments will have to come down substantially before they are going to be economically attractive.

The general pattern of these results at Murlong are consistent with a lot of the current research into poorly performing sands. These messages include:

- Where sand is compacted, physical disturbance is providing very good returns in both crop performance and economics. Compaction in sandy soils is common in paddocks which have a substantial cropping history.
- Disturbing sands increases erosion risk.
- Incorporating amendments (especially high rates of N rich organic matter) with these physical disturbance operations often produce much better crops, but rarely have those amendments been financially attractive so far. There is currently a lot of activity into refining amendment strategies to improve their cost-effectiveness.

Further paddock scale validation trials and farmer demonstrations were established at Kimba, Mount Damper, Karkoo and Cummins in 2019 in partnership with EPARF and LEADA; see report in this edition by Brett Masters for details of those complementary trials.

**Impact of rate of incorporated lucerne on wheat production.**
In a new trial set up in 2019 at Brooker on the Lower Eyre Peninsula, lucerne hay incorporated by spading had little impact on wheat performance at rates equal to or below 2 t/ha, there was little further increase in crop productivity above 15 t/ha but between these two rates, for every 1 t/ha increase in lucerne, wheat grain yield increased by 0.2 t/ha.

This site was also on a deep, unproductive and severely repellent siliceous sand.

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