Ameliorating a compacted, acidic red sand

CASE STUDY 8

SNAPSHOT

Farmer name: Mark Dolling
Location: Kielpa, SA
Farm size: 1800 ha
Enterprise: Cropping
Average annual rainfall: 375 mm

KEY MESSAGES

- All machines helped alleviate soil compaction and improve biomass.
- Due to variability in responses and control plot characteristics, there is no clear 'winner' in terms of machinery.
- Measure pH before tillage. If subsoil acidity is an issue, tillage is an opportunity to incorporate lime into the acidic layer.

SANDY SOIL CONSTRAINTS

Water repellence | Compaction | Acidity

Area of land affected (ha): 500 | Area of land affected (%): <1

Trialled
Various machines to reduce compaction and bring up clay to treat water repellence and acidity. Machines compared in trial included:

- Grizzly plough
- Farmax spader
- Bednar ripper
- Lienert delver
- Agrowplow® with inclusion plates

INTRODUCTION

Mark Dolling's 4,500 ha property at Kielpa has been in the family for 100 years, with Mark managing it since 2013.

Sandy soils cover about 500 ha of the farm with acidity, compaction and water repellence the key issues. Water repellence is the major issue and dry seasons are challenging.

"If there's an early break and the soil wets up, the sandy soils yield just as well as other parts of the paddock. But with a poorer start to the season, the average spring yield is down by 0.5 to 1 t/ha," said Mark.

With a dry finish the sands can yield better than the heavier soil on the flats.

In the past, Mark has tried a small amount of delving to test effectiveness. This resulted in a reasonable improvement in yields and the next step is to determine the most economical way (i.e. which machine to use) to give the best result.

THE TRIAL

The 2023 trial aimed to assess which tillage machine did the best job at bringing up clay to treat water repellence and acidity, and alleviating compaction. The trial was run on an acidic sand (Figure 1), with alkaline subsoil roughly 20 cm deep. Soil pH was 5.2 from 0-5 cm, and 4.65 from 5-15 cm (Table 1).

THE TRIAL cont...

Lime was spread at a rate of 2 t/ha on the soil just before the trial was implemented on 21 March 2023. Machines tested included:

1. Grizzly ripper
2. Farmax spader
3. Bednar ripper
4. Lienert delver (3-tyne delver)
5. Agrowplow® with inclusion plates
6. Grizzly ripper followed by Farmax spreader

The trial was unreplicated plots, 15 m wide x 100 m long.

The treatments left the soil soft and with a rough surface. Mark ran a chopper chain over the paddock to level it out, then sowed wheat at a 45-degree angle to reduce machine sinkage.

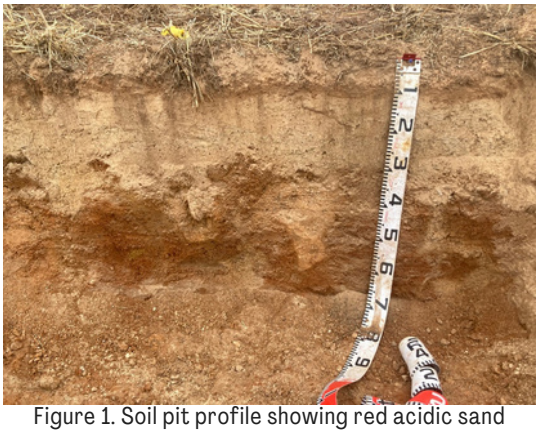

Figure 1. Soil pit profile showing red acidic sand

Table 1. Soil acidity pH (1:5 $CaCl_2$) at Kielpa, 24 March 2023

	Soil type	
Depth (cm)	Red Sand (east)	White sand (west)
0-5	5.2	5.0
5-10	4.6	4.7
10-15	4.4	4.4
15-20	6.6	4.6

RESULTS

Water repellence

Water repellence data collected in April 2024 indicated that it was eliminated in the spader, Grizzly + spader, and Bednar treatments (Figure 2; MED = 0). Minor repellence was still evident in the 3-tyne delver, Agrowplow® + inclusion plates, and Grizzly ripper plots.

Compaction

Figure 3 compares how well each implement alleviated compaction to 500 mm depth.

Variability between the control plots means there is no clear takeaway other than every form of tillage lowered penetration resistance. The Agrowplow® with inclusion plates worked best to alleviate compaction to 350 mm and was the only treatment to lower penetration resistance below 2500 kPa (the point at which root growth is significantly hindered) to 500 mm depth. However, there was no significant difference between treatments.

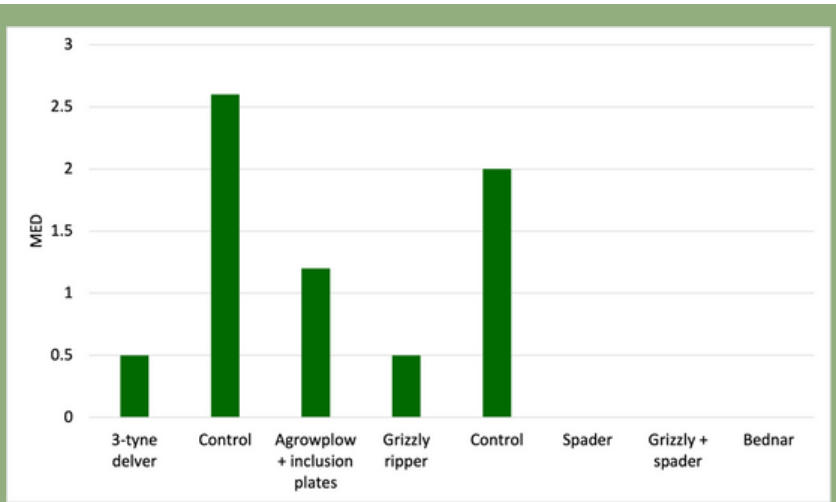

Figure 2. Water repellence readings using the Molarity of Ethanol Drop (MED) test.

Biomass

Based on late biomass data (Figure 4), the Grizzly ripper gave the best response followed by the 3-tyne delver. However, many treatments (spader, Agrowplow® + inclusion plates, Grizzly + spader) performed similarly to Control 1, reducing the confidence of a reliable response.

Control 1 had a noticeable compaction layer compared to the other treatments, however, removing the compacted layer in Control 2 did not seem to improve biomass.

During harvest at the end of 2023, Mark said, "we didn't set one AB line for all the machines, so we couldn't really follow it with the header and couldn't get yield data. But we can certainly tell where the ripping wasn't done. Those areas yielded 0.5 t/ha or less."

> "I could see the distinct line all year [between plots] where the ripping was and wasn't done," said Mark. "Most plots looked similar, but the best looking plots were the delver and spader."

> "It doesn't matter what machine you use, there is a positive result. There was a $20,000 machine and a $50,000 machine, and they did the same thing."

Economics

"Delving, if you have your own gear is economical, but paying some else is too expensive. You need a big horsepower tractor to do it," says Mark.

As each machine made an improvement, Mark is comfortable that any ripping will help.

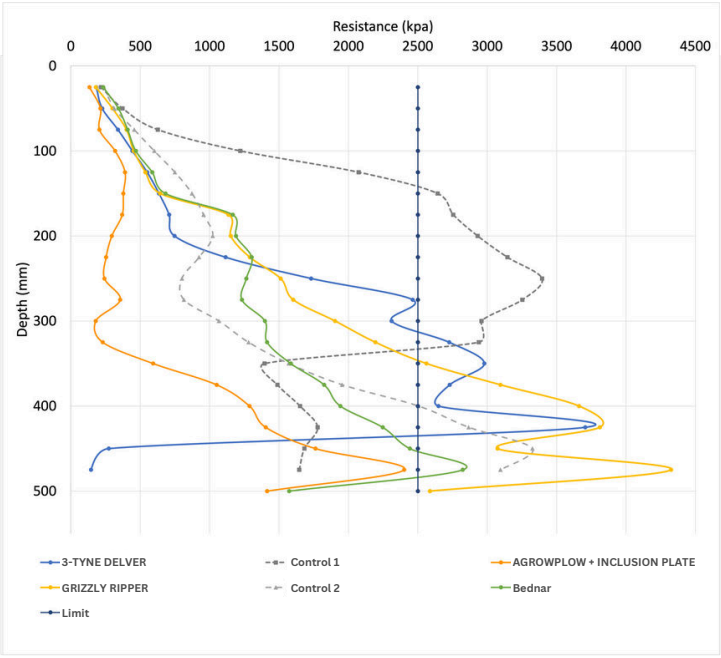

Figure 3. Penetrometer resistance at depth for some of the treatments compared the theoretical biological limit. Measured after significant rainfall in December 2023

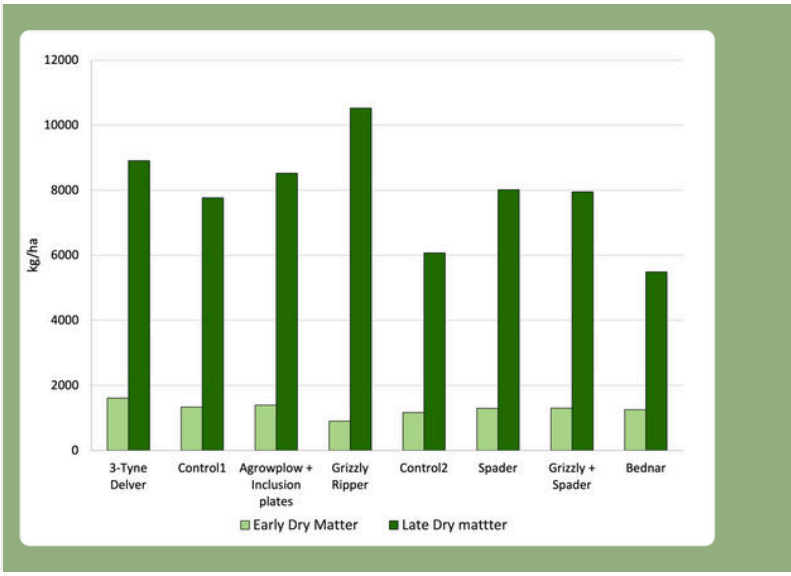

Figure 4. Wheat dry matter production (kg/ha) in red sand (east) for the different treatments at Kielpa, 2023. Early (27 July) and late biomass (9 October) data.

NEXT STEPS

Based on the trial, Mark is looking at buying his own machine rather than relying on contractors that are not always available when needed. As all machines performed similarly, Mark is looking at cheaper machines.

“It doesn’t matter what machine you use, there is a positive result. There was a $70,000 machine and a $200,000 machine, and they did the same thing,” Mark said.

This project is being led by AIR EP and has been funded through the Australian Government’s Future Drought Fund and the Grains Research & Development Corporation (GRDC), and is supported by the South Australian Drought Resilience Adoption and Innovation Hub. Project delivery partners are Mallee Sustainable Farming (MSF), Northern Sustainable Soils (NSS), MacKillop Farm Management Group (MFMG) and the University of South Australia Agricultural Machinery Research & Design Centre (UniSA), with technical support provided by Primary Industries and Regions South Australia (PIRSA), CSIRO, Soil Function Consulting, Frontier Farming Systems and Trengove Consulting. Case studies compiled by Alluvio Pty Ltd.

RESOURCES

AgriKnow: https://www.agriknow.com.au/trial/44

PROJECT INFORMATION

Trial monitored by PIRSA-SARDI.
Many thanks to Mark Dolling for hosting the trial.

Building drought resilience by scaling out farming practices that will enhance the productive capacity of sandy soil landscapes.
Activity ID: 4-H6P3CX5

Produced April 2024