Deep tillage and carbon-based nutrition to improve sandy soils

CASE STUDY 5

SNAPSHOT

Farmer name: Ben Ranford
Location: Arno Bay, SA
Farm Size: 3700 ha
Enterprise: Cropping
Average annual rainfall: 330 mm average (255 mm 2022 GSR)

KEY MESSAGES

- Ripping delivered substantial yield increases.
- Adding the carbon-based fertiliser did not improve yields compared to mineral fertiliser alone (the control).

SANDY SOIL CONSTRAINTS

Low fertility

Water repellence

Compaction

Area of land affected (ha): 600 | Area of land affected (%): 16

Trialled

- Carbon-based nutrition
- Companion planting with peas
- Deep tillage – deep ripping + soil mixing of top 20 cm

INTRODUCTION

The Ranford family began farming at their Arno Bay property on the Eastern Eyre Peninsula in 1989. Current owner Ben Ranford grows cereals and legumes in rotation. Cereals are sown across the paddock but when growing legumes, he sows vetch or lupins on the sands and lentils in the swale.

The soils are sandy to loamy soils with sodic, calcareous subsoils, and sand dunes are part of the landscape. Low productivity sandy soils affect about 600 ha of the property. Water repellence, compaction (10-20 cm depth) and low fertility are the main issues.

The sandy soil constraints can mean a 75% reduction in crop yield if the crop doesn't establish well. Even when the crop is established, there's approximately a 25-30% reduction in yield most years compared to good loamy soil. "The sandy soils don't have the nutrients to support the crop growth," says Ben.

In the past, Ben has tried a few things to improve establishment on the water repellent soil including press wheels and in-furrow wetters to improve establishment and spading. Most things he has tried worked, but tended to be short-term, improving establishment but not longer-term productivity.

Ben has also tried delving to bring up clay to treat water repellence and improve soil fertility. He used a Bednar Terraland with wide delving tynes and wide plates to bring up more clay, followed by spiked rollers to incorporate the clay into the topsoil. Delving to the correct depth is critical as the subsoil clay is sodic.

Ben said, "It's not perfect clay to bring up. We find if you take the first few inches of clay, this is where most of the nutrients are perched, and the sodic clay helps wet up the sand. If you dig about 6 inches into the clay, it changes from creamy grey coloured clay [better clay] to brighter orangey-brown clay [more sodic]."

After delving, Ben notes that you can see the wheat roots concentrating around or 'hugging' the creamy grey clay.

THE TRIAL

The sandy soil trial aimed to address water repellence, compaction and low fertility. Treatments were:

1. **Nil:** Standard practice of 25 kg/ha DAP and SOA preseeding; 10 kg/ha DAP and SOA at seeding (basal)
2. **Nil + rip:** Deep ripping to 40 cm + soil mixing of top 20 cm with the Bednar Terraland to alleviate compaction and water repellence. Deep ripping used a Bednar plough with tynes on a 0.5 m spacing
3. **Manure:** Manure was 100 kg/ha Neutrog Bounce Back® to boost soil fertility
4. **Manure + rip:** Manure applied pre-ripping
5. **Nil + peas:** Companion planting with peas to boost in-season N supply.
6. **Nil + peas + rip:** Unfortunately, due to a mix up at sowing this treatment only had one replicate

Every treatment received the basal fertiliser rate of 10 kg/ha SAP/SOA at seeding.

The trial soil had a neutral pH to 20 cm depth, then increasing pH to 50 cm. Soil fertility was low, with organic carbon at 0.67% from 0-10 cm and an ECEC of 4.25 cmol+/kg. In 2022, the site was sown to Vixen wheat. In 2023, the site was sown to pasture and the trial pegs were removed. As such, this case study only reports the 2022 data.

RESULTS

In 2022, to minimise the impacts of wind erosion, Ben sowed the site twice with a disc seeder with the second sowing pass at a 45-degree angle to the original sowing lines (Figure 1). This resulted in higher than recommended plant densities.

Crop growth differences were evident between treatments throughout 2022, with the three ripped treatments showing greater biomass than unripped treatments (Figure 2 and Figure 3).

This trend continued through to harvest, with the ripped treatments yielding the highest (Figure 4). Ripping + companion planting with peas had the highest yield overall, however there was only one treatment, so it is difficult to know if this result is an outlier.

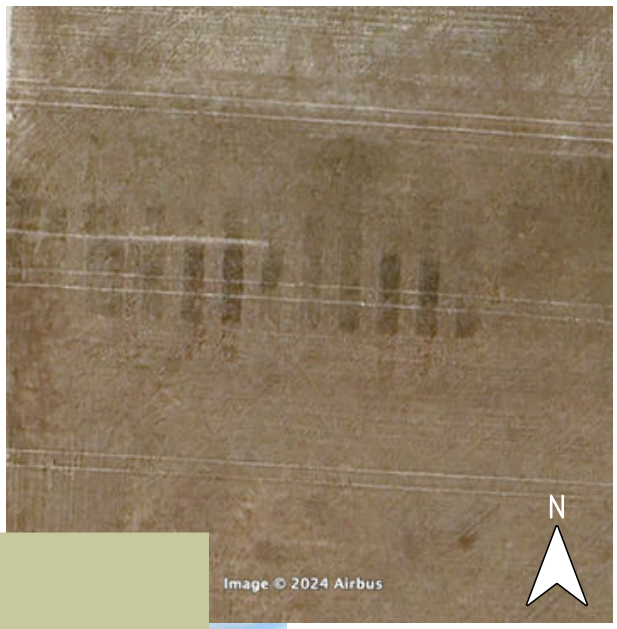

Figure 1. 45 degree sowing to manage erosion risk.

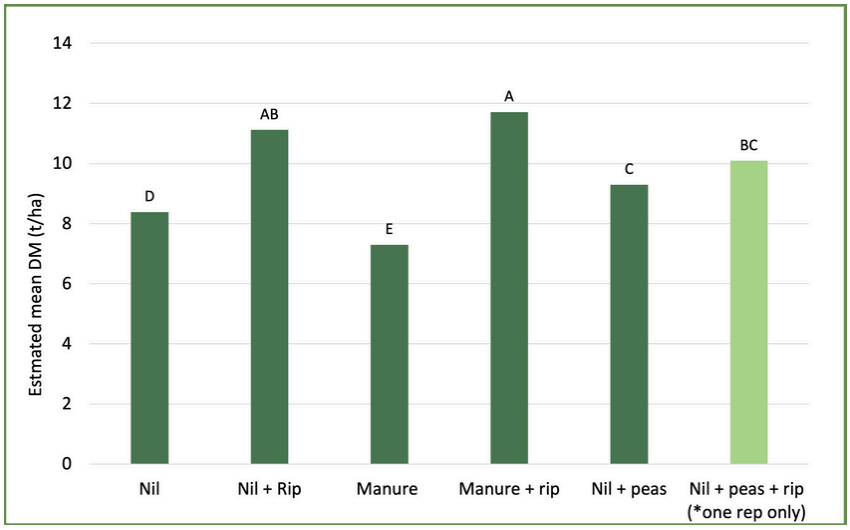

Figure 2. Spring biomass (t/ha dry matter) at Arno Bay in September 2022. A different letter indicates a significant difference.

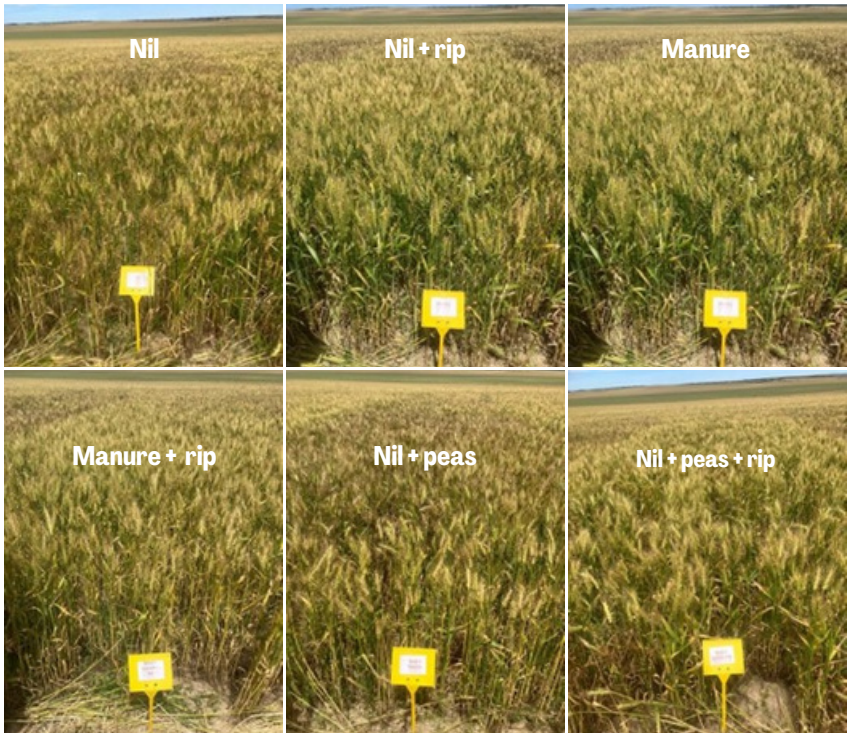

Figure 3. Biomass growth in October 2022

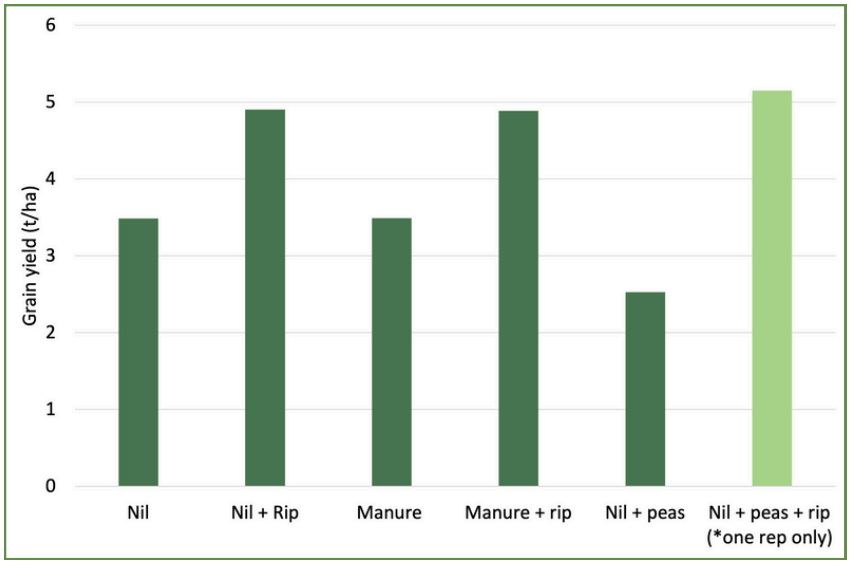

Figure 4. Wheat yields at Arno Bay, December 2022

The various nutrition products had little impact on yield. Applying the carbon-based fertiliser (Neutrog Bounce Back®) did not improve yields compared to using mineral fertiliser alone (the control).

In 2023, the site was sown with a cover crop of vetch and tillage radish which was terminated in spring. The plot treatment pegs had also been removed. As such, crop data was not collected in 2023.

Although the site wasn't pegged out in 2023 and Ben didn't have the trial plan, he could see 'tiger stripes' of increased biomass and thicker plants on soil that had been ripped.

"We dug holes to confirm we were looking at ripped and unripped, and could see different soil structure," said Ben.

Economics

Ben says the rough cost of ripping is $100/ha, and the yield boost more than covers the cost.

"With wheat at $400/t, the gross returns were $600/ha on the unripped country and $1600 on ripped country. After the cost of ripping, there's still nearly $1000/ha extra income in year one," Ben said.

"Yes we need to use higher fertiliser rates to account for the new yield potential, but ripping is a no brainer."

NEXT STEPS

Ben will continue delving to treat both compaction and water repellence, as he wasn't satisfied with the job in comparison to previous efforts.

"It takes a while to work out how to get the best out of the machine," Ben said.

"When we first started, we weren't being aggressive enough and didn't bring up as much clay as ideal. I want to go over what we did 2 years ago, but at right angles. If you go over at the same direction, the tynes might just find their way into the slots that were already done."

NEXT STEPS CONT..

The plan is to delve when he notices the benefits (lower water repellence, improved nutrition) starting to decline. Over time, Ben thinks the water repellence will improve as the clay clods break down and are mixed in with the topsoil.

“Where the clay has been mixed with the sand it has treated the water repellence, the crop establishment and growth have improved, and nutrition is absolutely stellar. The problem is you don’t get homogenous mixing. We only sow with a disc seeder with little disturbance, where the clay is fantastic, but there are still pockets of water repellent soil between it without the clay.”

To speed things up, Ben is sowing at right angles to last year’s row with an Alpha Disc seeder, which disturbs and mixes the soil more than his previous machine.

Erosion is the main challenge to manage after ameliorating the soil. The tops of the sand hills are more vulnerable to erosion, which is why be tries to sow as soon as possible afterwards.

“Even though the soil is very soft after amelioration, the new disc seeding machine has excellent flotation because the discs and press wheels are so close together. Rolling the ameliorated sand with a land roller before sowing does firm and even up the soft soil, improve trafficability and aid seed placement,” Ben said.

Once the soil amelioration plan is complete, Ben will return to controlled-traffic farming and no-till to build soil carbon and feed soil biology. Based on trial results to date, Ben is also considering companion planting as a practice.

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RESOURCES

AgriKnow: https://www.agriknow.com.au/trial/45

PROJECT INFORMATION

This trial was established under the EP Landscape’s Board “Regenerative Agriculture Program” (EPLB RAP) funded by the National Landcare Program project with additional support from the Soils for Life ‘Paddock Labs’ project. Trial run by PIRSA.
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Building drought resilience by scaling out farming practices that will enhance the productive capacity of sandy soil landscapes.
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