Deep ripping responses across multiple soil types

CASE STUDY 15

SNAPSHOT

Farmer name: Simon & Lisa Craig
Location: Kooloonong, Vic
Farm Size: 7000 ha
Enterprise: Cropping & sheep, two farms
Average annual rainfall: 320 mm, 220 mm GSR

KEY MESSAGES

- On sandy dune soils, deep ripping gave a considerable economic benefit. Gross margins ranged from $500 to $1000/ha.
- The benefits and returns from ripping decrease down the slope as clay content increases.

SANDY SOIL CONSTRAINTS

Water repellence | Compaction | Low fertility | Acidity (topsoil of deep sands)

Area of land affected (ha): 700 | Area of land affected (%): 20% of the northern farm, 10% of the whole farm

Trialled

- Deep ripping

INTRODUCTION

Simon Craig and wife Lisa manage Lemac Farm, a 7,000 ha broadacre grain and sheep farm near Kooloonong, Victoria. The family farm operation is spread across two properties and shared with Lisa's parents, Roger and Christine McQueen.

The soils at the farm are predominantly sands to sandy loam, with limited clay. The deep sands extend to well below crop rooting depth and there are only small sections of heavier soils on the flats. "The flats are compacted and heavier ground, but still sandy," says Simon.

Low productivity sandy soils affect about 10% of the farm. Soil constraints include compaction, low fertility, acidity in the topsoil of the deep sands, and some water repellent soil. The yield difference between the sand hills and other parts of the paddock can be about 2.5 t/ha.

INTRODUCTION cont...

Simon is keen to improve crop growth higher up on the sandhills to both boost yield and stop Mallee seeps from forming. “At the end of the year we can see moisture unused, which is creating seeps across the farm and we are losing ground to salinity, and the soil is not trafficable.”

Getting crop roots deep enough to use the excess moisture is the aim, and ripping is the first step. Finding the right crop and process is important. Simon says, “summer growing weeds e.g. skeleton weed with a big tap root leave the soil open but take all the moisture. We need something to open the soil but not take all the moisture, to give us good access to deeper moisture.”

Ripping seems to solve the issue, though on these soils it is only a temporary fix.

“Even after ripping, the soil sets hard again. When you get a lot of rain, the sand particles settle and fill up the pores,” says Simon.

> “20-30 years ago sand hills were the saving grace, but now it’s the other way round. They’re the problem. Since 2010 they ‘went wrong’, possibly we were working when wet and compacted a lot of soils,” says Simon.

THE TRIAL

The aim of the trial was to identify which Mallee soil types gave the best return on ripping.

Deep ripping treatments were implemented in March 2021 to a depth of 500 mm, using straight shank Tilco tynes. Each treatment strip was 250 m long and traversed three commonly encountered soil positions within the Mallee landscape - the dune, midslope and swale. The deep ripping treatment was only applied once and was not repeated in subsequent seasons.

The site was sown to the following crops over three consecutive seasons:

- Barley (var. Commodus) on 11 June 2021
- Chickpea (var. Genesis 090) on 28 April 2022
- Wheat (var. Razor CL) on 22 May 2023

Soil properties

Soil properties of the three main soil types are:

- Dune: Deep sandy soil. Low fertility and soil carbon (0.29%). Slightly alkaline topsoil and alkaline below 40 cm depth. High soil resistance (Figure 1) with levels exceeding 2000 kPa from 17 cm below the surface. Severe resistance from 30–40 cm
- Midslope: Sandy loam soil. Low carbon and phosphorus. Neutral topsoil pH becoming more alkaline with depth
- Swale: Clay loam soil. The soil profile was alkaline throughout with salinity and boron levels becoming high below 60 cm with root growth expected to be constrained below a depth of 80 cm

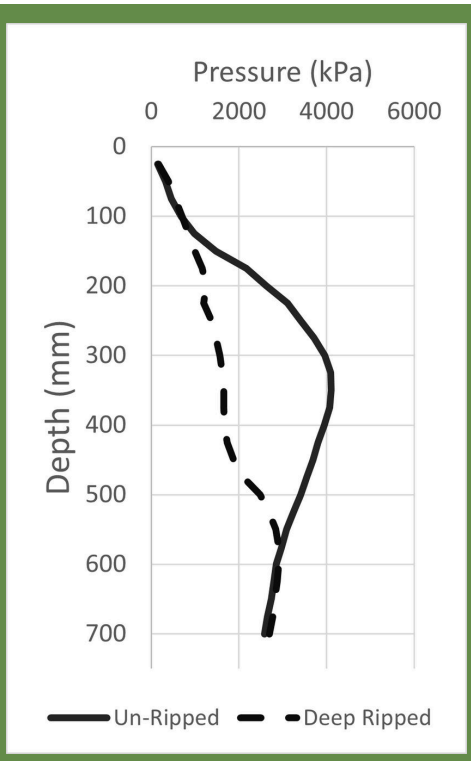

Figure 1. Penetration resistance measured down the sandy “dune” soil profile using RIMIK CP402 cone penetrometer for un-ripped and deep ripped treatments.

RESULTS

Soil Compaction

Deep ripping successfully alleviated compaction on the dune soil down to 50 cm (Figure 1).

Yield

Over three years, ripping consistently increased yield on the dune soil. The benefits of ripping decrease moving down the slope as soil clay content increased.

In the 2021 barley crop, there was a significant yield increase on the sandy dune soil with an average grain yield benefit of 0.8 t/ha. At the transition to the midslope (landscape position 8, Figure 2) the barley crop was no longer responsive to deep ripping. From the lower midslope into the swale, there was a negative response to deep ripping.

RESULTS cont...

In the 2022 chickpea crop, deep ripping increased yield up to 0.7 t/ha on the dune soil (Figure 3). There was no significant yield improvement on the midslope or swale.

In the 2023 wheat crop, as with 2021 and 2022, the greatest yield benefit was on the sandy dune, with an average yield increase of 0.48 t/ha (Figure 4). There was a smaller yield benefit from deep ripping (0.23 t/ha) across the lower midslope, but no benefit from deep ripping on the clay loam soil of the swale.

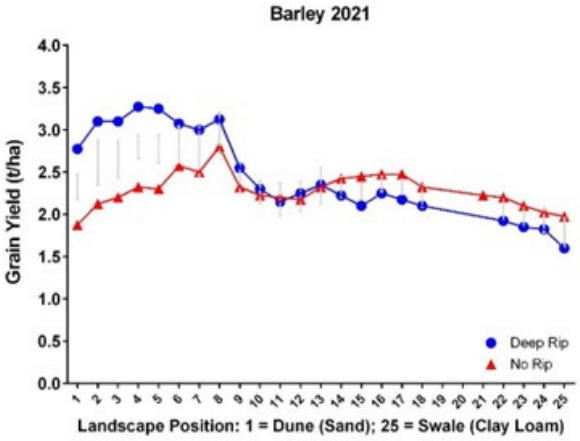

Figure 2. Barley grain yield in 2021

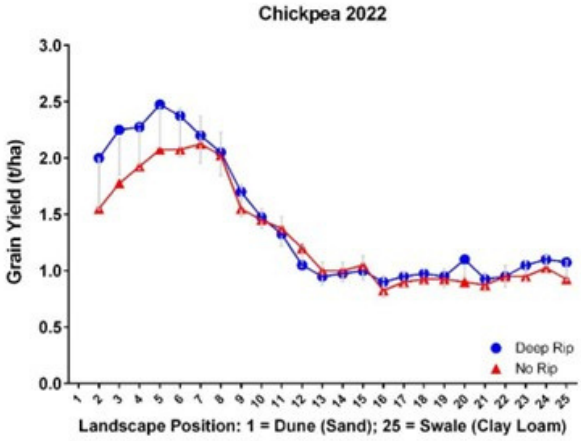

Figure 3. Chickpea grain yield in 2022

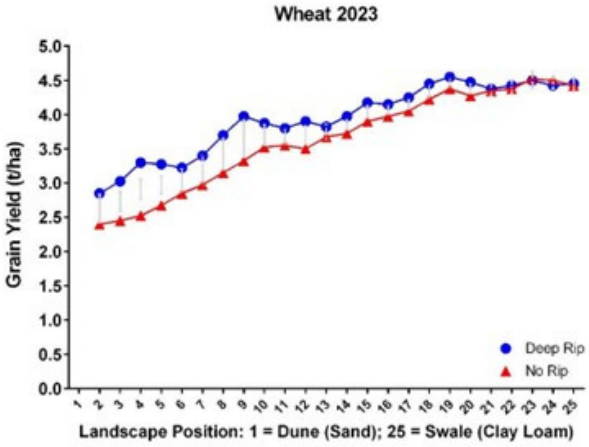

Figure 4. Wheat grain yield in 2023

> "We could see the difference from year one. We can clearly see the difference [in crop growth from ripping] at the top of the hill and not as much of a response on the mid slope or the flat," says Simon.

ECONOMINCS

The additional gross margin generated by deep ripping (compared to un-ripped soil) was calculated across the three seasons of the trial (Figure 5). Partial gross margins were calculated at each of the 25 landscape positions with the following assumptions:

- Grain price (barley $310/t, chickpea $1000/t, wheat $400/t)
- Deep ripping costs $120/ha
- Additional nutrient costs
  - Nitrogen (N) removal: 20 kg/t for cereal @ $1.5/kg of N
  - Phosphorus (P) removal: 4 kg/t for cereal and 6 kg/t for chickpea @ $5/kg of P

Deep ripping was most profitable on the sandy dune soil, with gross margins between $500/ha and $1000/ha over the three years. On the lower midslope and swale soils with higher clay content, the gross margin benefit from deep ripping was less than $200/ha.

NEXT STEPS

Simon has been ripping for years to deal with compaction, using a K-Line ripper on 60 cm spacings and ripping to 40 cm depth. Based on the trial and seeing how various parts of the landscape respond to ripping, Simon is now ripping less of the paddock but more regularly.

“We used to rip 30-40% of the paddock every 3–4 years, but now do only about 15% (the sand hills) every 2–3 years,” he said.

“The trial has confirmed that we don’t need to rip as much as we have done in the past. It has been beneficial to see as we don’t want to rip unnecessarily, it’s time consuming and leaves it [the soil] prone to erosion. To show you can do the caps and get responses, that’s great.”

Ripping depth, poor trafficability and seeding issues after amelioration are issues Simon needs to iron out. “In the year after ripping we lift the bar fully up to broadcast the wheat on top, then come past again and tickle it in with the bar and turn the herbicide off,” Simon said.

He uses this process to maximise cover, as he found that the weight of the bar and box when travelling over the sand hills was too much in the soft soil after ripping.

“The bar dropped down further so we were sowing too deep,” Simon said.

Broadcasting gives better cover post-amelioration to keep the soil protected.

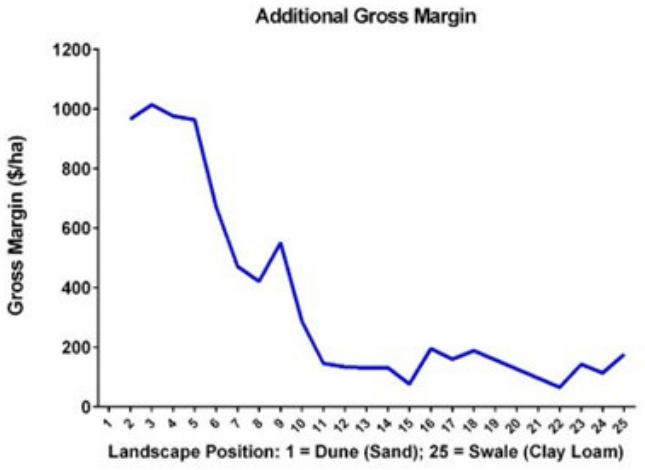

Figure 5. Additional gross margin benefit of deep ripping over un-ripped soil in barley (2021), chickpea (2022) and wheat (2023) following deep ripping in 2021.

Comparison between the unripped (left) and deep ripped (right).

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RESOURCES

Soil Hub: https://soilhub.com.au/front-page/kooloonong/#intro
AgriKnow: https://www.agriknow.com.au/trial/36

PROJECT INFORMATION

Project run by Michael Moodie, Frontier Farming Sysytems.
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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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