Investigating impacts of in-crop nitrogen applications and deep ripping to improve barley yields

CASE STUDY 14

SNAPSHOT

Farmer names: Keagan & Gareth Grant
Location: Chinkapook, Vic
Farm Size: 4500 ha
Enterprise: Cropping (90%)
Average annual rainfall: 300 mm

KEY MESSAGES

- Ripping and in-crop nitrogen applications increased barley yields. The highest yielding treatment (ripping + 100 kg N) also had the highest gross margin at $770/ha.
- Ripping alleviated compaction to 500 mm depth.

SANDY SOIL CONSTRAINTS

Low fertility

Compaction

Area of land affected (ha): 500 | Area of land affected (%): 10-15

Trialled

- Nitrogen fertiliser (25-100 kg/ha)
- Organic matter
- Ripping

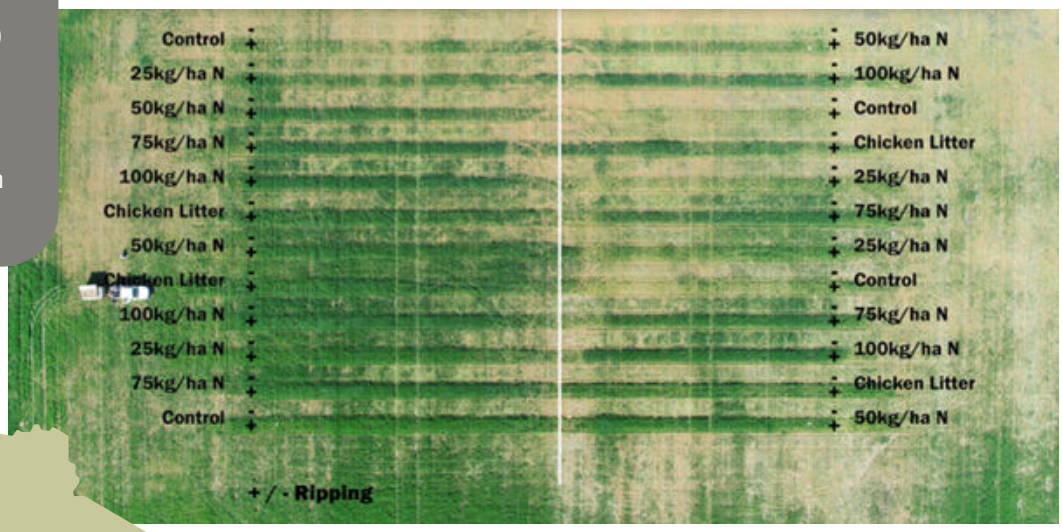

Figure 1. Trial layout

INTRODUCTION

Brothers Keagan and Gareth Grant manage the 4,500 ha family farm near Chinkapook in the Victorian Mallee. The farm has been in the family for nearly 100 years. Sandy soils on the property suffer from soil compaction and low fertility. “There’s a hardpan under the hills, probably from grazing and old farming practices,” says Keagan.

In an average or better year, the sandy soils yield about 20% less than the red loamy soils on the flats. In a poor year, the yield difference is about 50%.

“The sandy rises are the problem,” says Keagan. “They only cover small portions of the paddock but really push the yield down. If 20% of the paddock is a hill that only yields 2 t/ha and the rest of the paddock yields 4 t/ha, the overall yield drops down to about 3 t/ha.”

The Grant’s are looking for ideas to improve their sandy soils, noting that lack of machinery and labour have been a problem.

THE TRIAL

The soil at the trial site was sand to 20 cm depth with a gradual increase in clay to a sandy clay loam from 60-100 cm depth. Soil pH was neutral to alkaline. Nitrogen levels were very low, with just 26 kg N/ha in the top 60 cm, measured before sowing. Soil organic carbon was low at 0.4% from 0-10 cm. Soil phosphorus levels were adequate; however, trace element levels were generally low.

The soil was severely compacted from 15 cm depth, with penetration resistance readings exceeding 2000 kPa, and reading 4000 kPa at 25 cm depth (Figure 2).

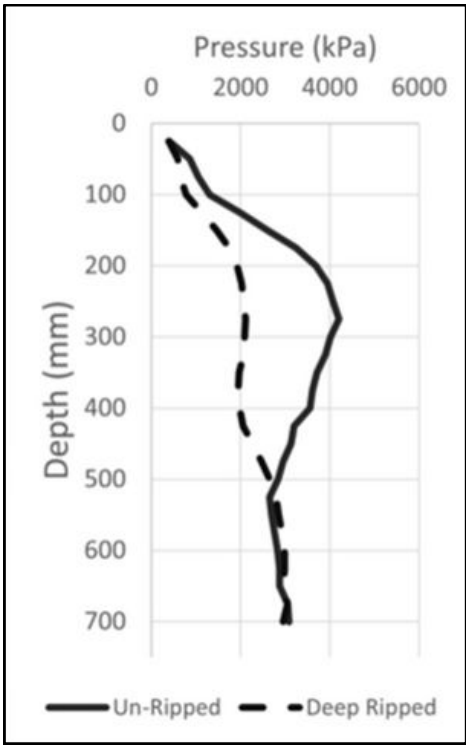

Figure 2. Average soil penetration resistance in unripped vs ripped treatments

The trial aimed to assess impacts of in-crop nitrogen (N) application and deep ripping on barley grain yield. Nitrogen rates included (Figure 1):

- Untreated control (Nil)
- Top-dress 25 kg N/ha (54.3 kg Urea)
- Top-dress 50 kg N/ha (108 kg Urea)
- Top-dress 75 kg N/ha (163 kg Urea)
- Top-dress 100 kg N/ha (217 kg Urea)
- Organic Matter (5 t/ha Chicken Litter Compost)

Each nitrogen treatment had a ripped and unripped plot.

On 18 April 2023, the site was deep ripped to 500 mm depth with straight shank Tilco tynes and chicken manure was applied. Chicken litter compost was spread on the surface of un-ripped plots and injected behind the ripper tyne in the ripped plots. On 24 May, the site was sown to Commodus$^{\Phi}$ barley. All treatments received starter fertiliser at sowing which applied: N at 16 kg/ha, phosphorus at 7.5 kg/ha, and sulfur at 7.5 kg/ha. Topdressed urea treatments were applied on 20 June 2023.

RESULTS

Soil properties

Deep ripping successfully reduced soil compaction to 500 mm depth, to <2500 kPa (Figure 2). This value is used as the threshold at which root growth is severely impeded.

> **"Ripping vs no ripping is chalk and cheese," says Keagan. "There was only half the yield in the non-ripped areas."**

Grain Yield

Deep ripping had the most impact on barley grain yield, resulting in yield benefit of 1.3 t/ha (Figure 3).

Yields increased as N-rate increased in both ripped and unripped treatments. The response to N was consistent with approximately 16 kg of barley grain produced for each 1 kg of N applied. This is equivalent to 7 kg of grain for each 1 kg of urea applied.

Barley yields reached around 4 t/ha when deep ripping was combined with an in-crop N application of 100 kg N/ha (217 kg urea/ha). The deep placement of chicken litter compost during deep ripping also gave a yield close to 4 t/ha.

In the un-ripped soil, 100 kg N/ha gave the highest barley yield (2.8 t/ha). Surface applied chicken litter in the unripped soil still gave a yield boost (1 t/ha above control), with a similar yield to applying 50 kg N/ha.

RESULTS cont...

Grain Quality

Grain protein increased at a rate of 0.175% for each 10 kg of N applied, up to 9.7% in ripped plots and 10.9% in un-ripped plots. Ripped plots had consistently lower protein levels (Figure 5). This is due to the dilution effect, where protein decreases as grain yield increases.

Protein levels were notably low on both ripped (8%) and unripped (9.1%) soil when no in-crop N was applied.

Other grain quality measures such as test weight (average of 72 kg/ha) and screenings (average of 2.2%) did not significantly vary between treatments and met or exceeded minimum grain delivery standards for all treatments.

Economics

Gross margins were calculated based on the combination of N rate x deep ripping.

Assumptions were:

- Grain price = $290/t (feed barley on farm)
- Base variable costs = $250/ha (excluding in-crop N)
- In crop N = $1.5/kg
- Deep ripping = $40/ha (annualised cost, $120/ha spread over 3 years)

Deep ripping treatments provided the highest gross margins, peaking at $770/ha when 100 kg/ha of N was applied (Figure 6). In un-ripped soil, the highest gross margin was $420/ha, also with the application of 100 kg N/ha. Gross margins in the deep ripping treatments were $330-350/ha more than the un-ripped treatments across all in-crop N application rates.

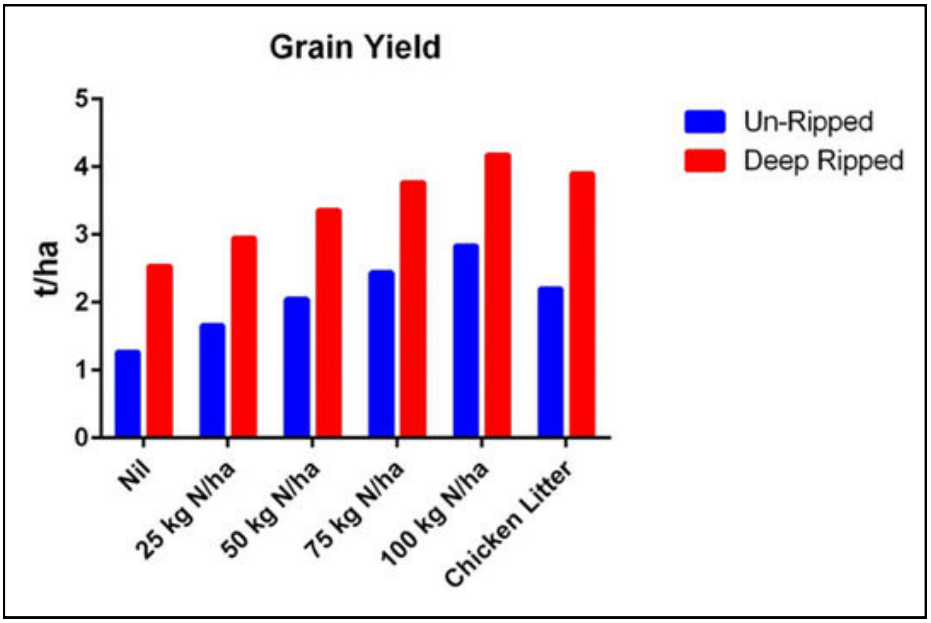

Figure 3. Barley grain yield in 2023

Figure 4: The deep ripping + 108 kg Urea/ha at the Chinkapook site

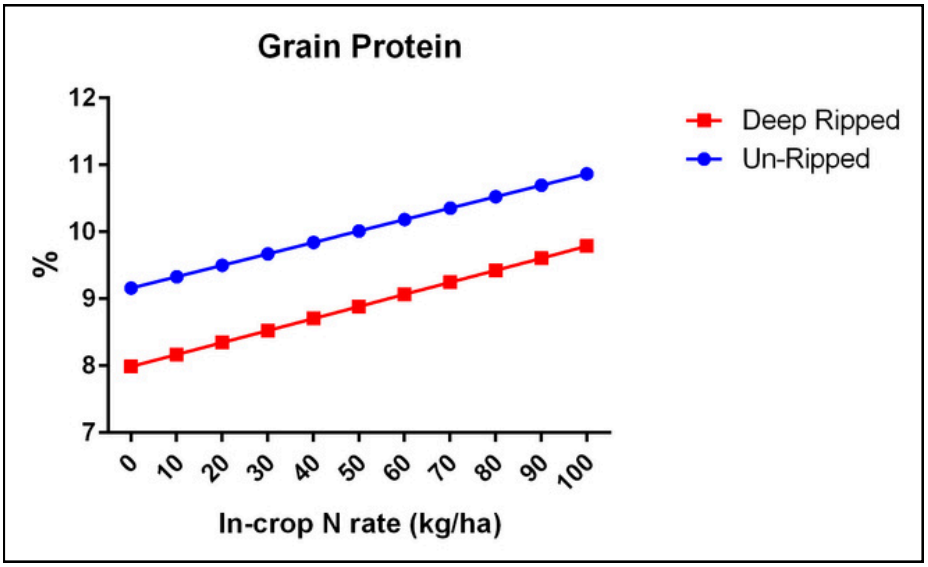

Figure 5. Grain protein in barley 2023

RESULTS cont...

On the whole, Keagan thinks ripping is worth the money, however there are restrictions.

"We don't have a tractor big enough to rip over the hills and pull the seeder through the country. And we can get bogged. So we will do small trials with a smaller ripper and see how we go seeding over them to start, and a new seeder and tractor might be on the cards in the future for an upgrade," Keagan says.

NEXT STEPS

Based on the trial, Keagan is keen to try ripping further on the farm once machinery issues are sorted. Erosion is also a concern.

"The hills already erode without ripping. Ripping helps the plants grow better, then when summer comes around you've got better cover. We're hoping it will mean less erosion later as there is twice as much biomass, deeper roots and better protective ground cover," Keagan said.

His plan is to rip and sow immediately, to get cover established as soon as possible.

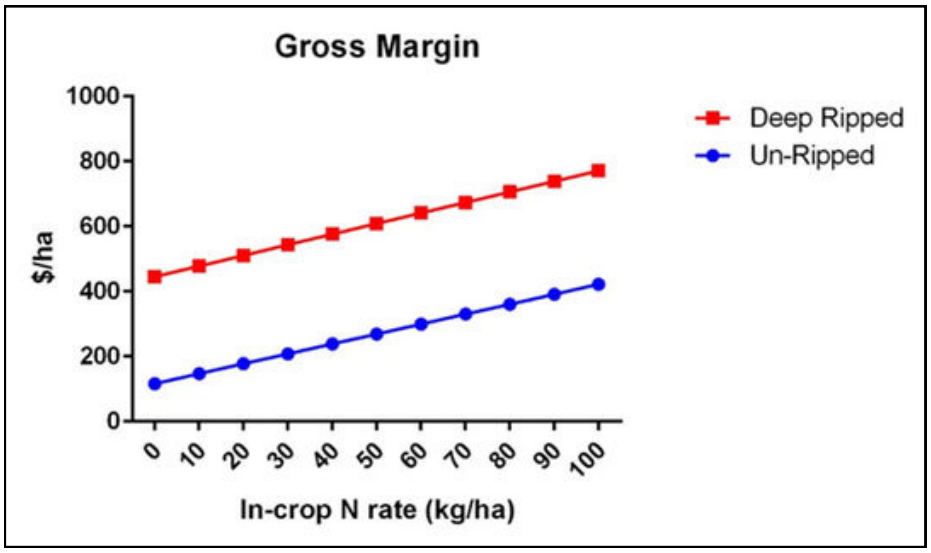

Figure 6. Gross margin ($/ha) comparison of deep ripped vs unripped treatments, with varying nitrogen application rates

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RESOURCES

AgriKnow: https://www.agriknow.com.au/trial/33

PROJECT INFORMATION

Trial run by Michael Moodie, Frontier Farming Systems.
Many thanks to Keagan and Gareth Grant for hosting the trial.

Building drought resilience by scaling out farming practices that will enhance the productive capacity of sandy soil landscapes.
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