Assessing the yield response to deep ripping over time near Nyabing, Western Australia. 2018 Harvest Update

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Key messages

1. Removing subsurface soil compaction can provide benefits over many years.
2. The economic returns of deep ripping accumulate with time, increasing the overall profitability of the practice.

Aims

To assess the impact of deep ripping on crop yield over a two year period on a farm near Nyabing, WA.

Method

Six sets of deep ripping strips were established in paddocks of consistent soil types at the Hobley family's farm south of Nyabing, WA in January 2017. Only one of those paddocks was cropped in 2018 and is examined in this report.

A 6 metre Ausplow was used to create plots 36 m wide, 1000 m long with a 400mm working depth. Plots were aligned with existing traffic lines which allowed three passes with the harvester. Each ripped plot had an undisturbed 'Control' plot either side (Figure 1).

The paddock was sown to wheat in May 2017 and barley in May 2018 with the growers Equaliser Min-Till Tine Seeder as part of the normal seeding operations. In 2018, Planet barley was sown in the northern trial area and Spartacus barley in the southern trial area. Only one control strip was used for the northern rip trial as the variety change occurred in the northern most control strip. Harvesting of the plots was carried out by the grower as part of their normal harvest operations and plots were not harvested separately. Yield data was recorded through the harvesters Topcon Yield Trak software and cleaned and calibrated in Quantum GIS (QGIS 3.6).

Yield response was determined by comparing the yield from the rip plot against the average of the two adjacent 'Control' plots with statistical analysis being conducted in Past3 software (Hammer et al, 2001).

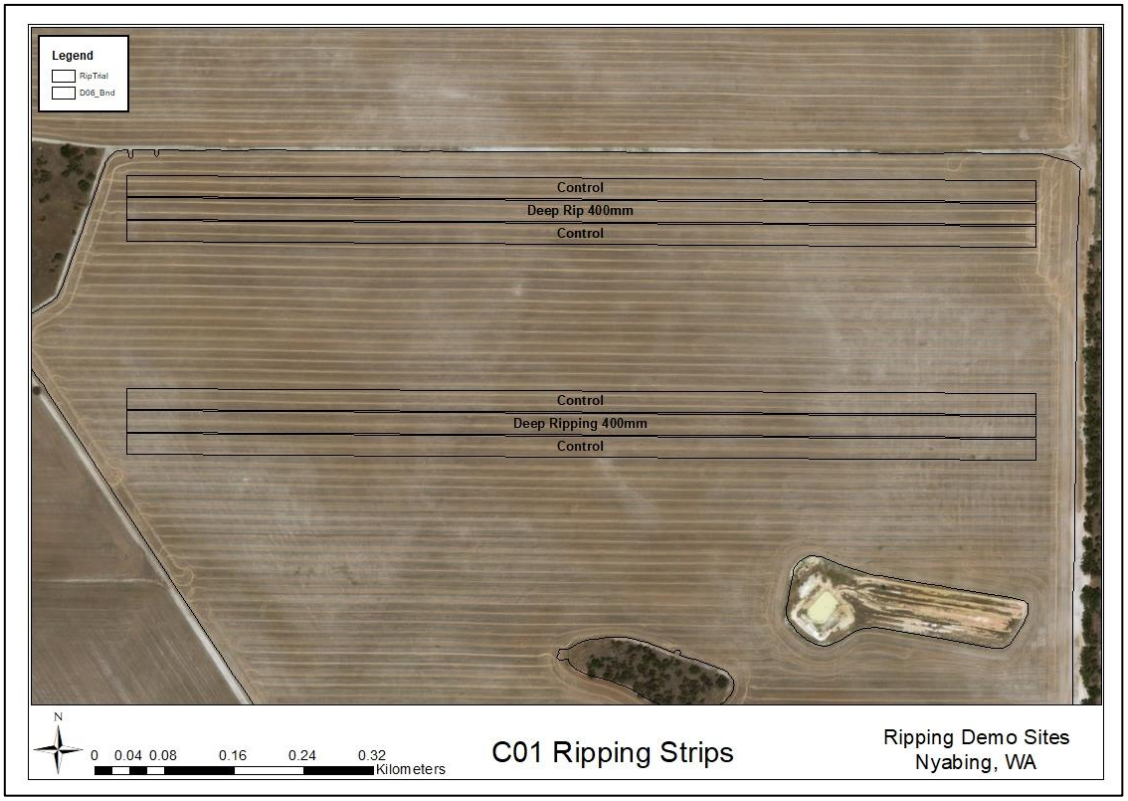

Figure 1: Deep ripping demonstration sites were established on the Hobley's farm near Nyabing in 2017. The sites consisted of a 36 metre wide plot ripped at 400mm. Undisturbed 'Control' plots allowed yield comparisons to be made.

Soil and plant measurements

A number of soil and plant measurements were collected during the 2017 and 2018 season in addition to yield.

Soil penetration resistance was measured at multiple locations along each rip and control plot using a Rimick CP300 Cone Penetrometer and used to assess differences in soil compaction. This was made up of five insertions at 10 locations along each of the two control strips and the ripping strip. Insertions locations were randomly chosen in the control plots though the ripping line was found and measurements taken from within the rip line for the ripped plots.

Figure 2: Cone penetrometer used to measure soil strength (left) and shears used t measure plant biomass (right)

Crop tiller density (tillers/m^2) and plant biomass (g/m^2) was also carried out at each soil penetrometer recording site to assess crop establishment differences. Normalised Difference Vegetation Index (NDVI) was collected using an Un-manned Aerial Vehicle (UAV) to assess differences in above ground plant biomass and plant greenness between plots.

Results and Discussion

Crop Yield

Significant yield increases were recorded in the ripped strips in both the 2017 and 2018 seasons when compared to the adjacent control plots (Figure 3). Yield increases ranged from 179 to 469 kg/ha (Table 1).

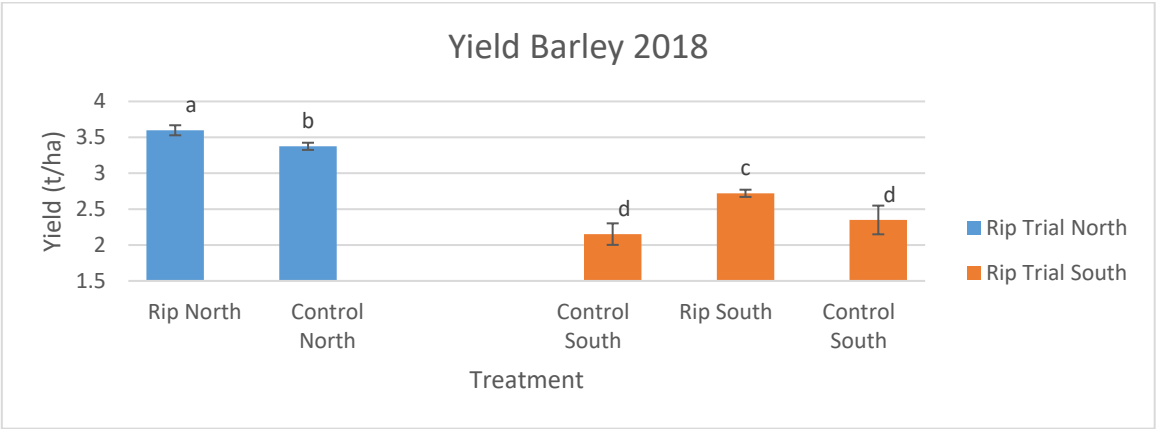

Figure 3: Average crop yield for the deep ripping and control plots showed that deep ripping provided a significant yield increase in both trial strips. It also showed that Planet barley had a significantly higher yield than Spartacus in this location.

Table 1: Estimated increase in yield as a result of deep ripping at six demonstration sites near Nyabing.

Ripping Trial	2017 Yield Benefit (kg/ha)	2018 Yield Benefit (kg/ha)
C01 North	179	223
C01 South	218	469
Average Benefit	199	346

Yield differences were measured between the barley varieties with the ripped and un-ripped Planet barley out yielding the ripped and un-ripped Spartacus barley though there was approximately 170 metres between the two trials.

Soil and Plant Measurements

Soil strength was reduced in the deep ripping plots when compared to the adjacent control plots in 2017 and was maintained into the 2018 season (Figure 4). 2018 measurements in the southern rip trial had increased and had more variation when compared to 2017. It is unclear if this represents a return to pre-ripping soil strength levels or if seasonal conditions (i.e. drier soil profile) are the cause of this change. No differences in the northern rip strip were observed.

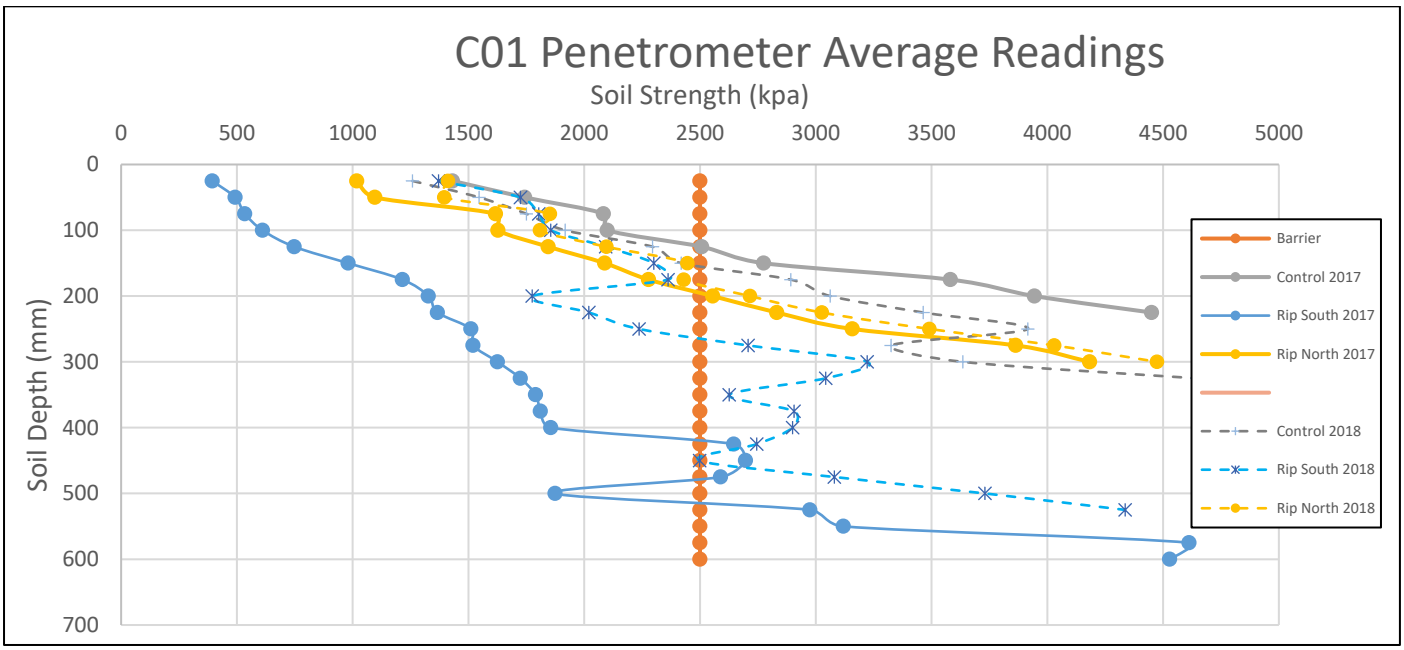

Figure 4: Comparison of soil strength measurements from ripped and control plots measured in 2017 (solid lines) and 2018 (dashed lines).

The control plots consistently reached 2500kpa between 150 – 300mm soil depth and increased to peak at 4500-5000kpa at 400 – 500mm depth. Deep ripping plots generally maintained compaction levels below 2500kpa to 400mm depth in the southern rip strips then increased to levels similar to the control plots. The penetrometer could not be pushed in further than 350mm in the northern rip strips and were also similar to the adjacent control strips. The ripped plots in the northern trial maintained higher levels of compaction than at the southern trial in both years.

Previous research has found 2500kpa to be the compaction level where plant root growth begins to be inhibited and indicates that the deep ripping did not fully remove compaction as a constraint in these areas.

Plant tiller density was measured by counting tillers along a 0.3m section of crop row at each penetrometer recording site (Table 2). This showed very even plant establishment and tiller density between the ripped plots and though there was a slight overall increase in the ripped plots there was no significant difference between the treatments.

Table 2: Crop tiller counts recorded at multiple locations in each plot showed no overall difference between treatments

	Avg. Tiller Density (tiller/m2)			
Ripping Demo ID	Ripped Plot		Control Plot	
	2017	2018	2017	2018
C01 North	402	356	396	350
C01 South	445	388	437	380
Average	398		391	

There were small visual differences in plant greenness in the ripped strips throughout the season though it was not consistent along the length of the plots. The imagery captured by the UAV shows only small differences in NDVI across the sites though ripped plots have small areas that have higher biomass than the adjacent control plots (Figure 4). The imagery also shows the difference in greenness of the Planet and Spartacus varieties and the need to drop one control plot from the northern trial.

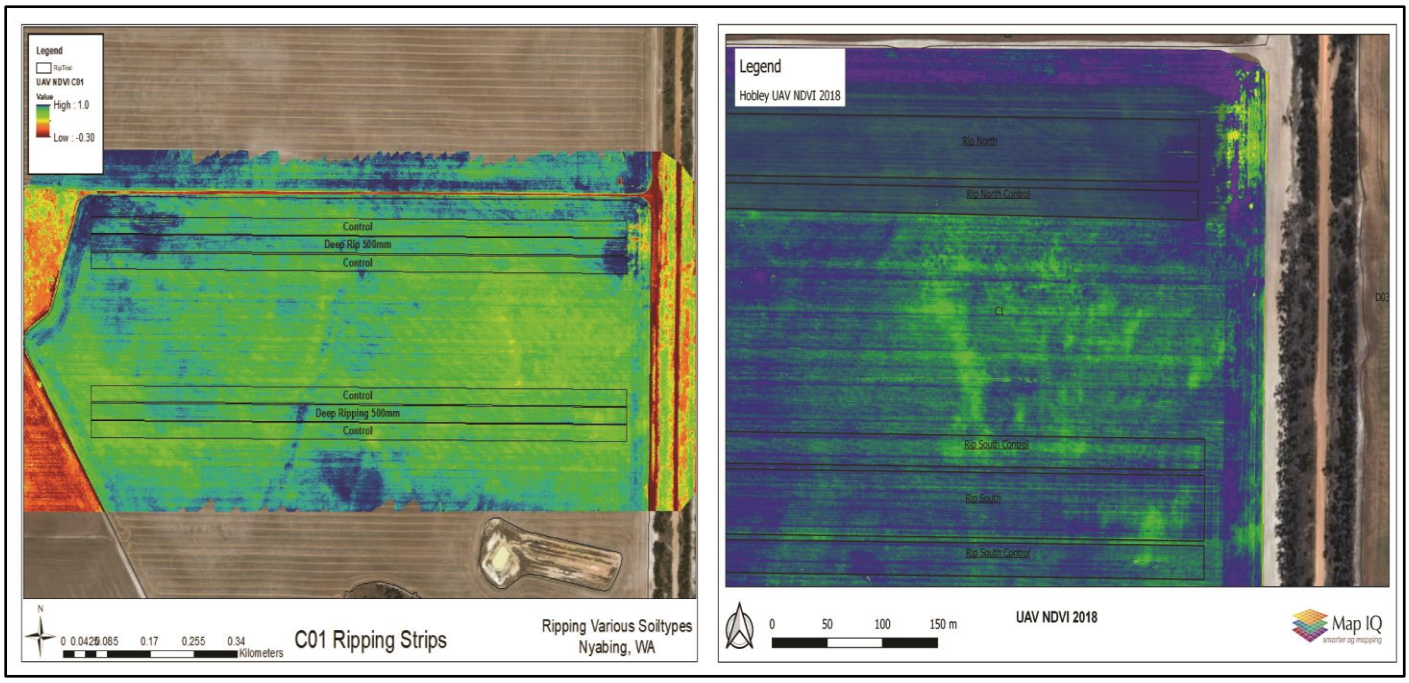

Figure 4: NDVI imagery shows biomass variation across the trial though no measureable difference between treatments

Returns of Deep Ripping

There was an average net benefit of $106/ha from the deep ripping treatment in this paddock over the control. The southern trial strip provided higher returns in both years of the trial with an average benefit of $91/ha over the two seasons. The northern trial had similar returns each season and averaged $55/ha.

These results are economically significant and make the deep ripping practice worth the effort, especially if the yield benefits continue over time. The longevity of the treatment effect will determine just how cost effective deep ripping is in this environment and on these soil types.

Table 3: The annual gross margin for each treatment and cumulated return over the two years examined.

Treatment	Treatment Cost ($/ha)	Amortised Treatment Cost over two years ($/ha)	Benefit from Ripping 2017 ($/ha) Wheat @ $300/t	Benefit from Ripping 2018 ($/ha) Barley @ $250/t	Return on Investment over two years ($/ha)
Control	-	-	0	0	0
Deep Rip North	40	20	54	56	69
Deep Rip South	40	20	65	117	143
Average	-	-	60	87	106

Conclusion

The significant yield increases have made deep ripping economically profitable in the two seasons this trial has been run. Ongoing yield increases are likely to continue and will provide a positive return on investment to the farm business. The longevity of the deep ripping effect will determine how large the economic benefit will become though it has already provide a profit.

Acknowledgments

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