Assessing the yield response to deep ripping over multiple sites across a farm south of Nyabing, Western Australia.

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Key messages

1. Subsurface soil compaction has been shown to be a major constraint to crop production and its removal of this compaction via deep ripping can lead to large yield increases.
2. Assessing yield responses on different soil types will guide where future deep ripping work is carried out, with priority given to those soils with the greatest yield increases.

Aims

To assess the impact of deep ripping on crop yield across varying sites on a farm near Nyabing, WA.

Method

A series of deep ripping strips were placed in six locations that covered similar soil types across the Hobley family’s farm south of Nyabing, WA. Treatment strips were setup in January 2017 using a 6 metre Ausplow at a 400mm working depth. Plots created were 36 m wide and aligned with existing traffic lines which allowed three passes with the harvester. Each ripped plot had an undisturbed ‘Control’ plot either side (Figure 1). Plots ran the full length of the paddock and ranged from 700 to 2200 metres after the headlands were removed.

All sites were sown with the growers Equaliser Min-Till Tine Seeder in May 2017 as part of the normal seeding operations. 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 3.0). Yield response was estimated by comparing the yield from the rip plot against the average of the two adjacent ‘Control’ plots.

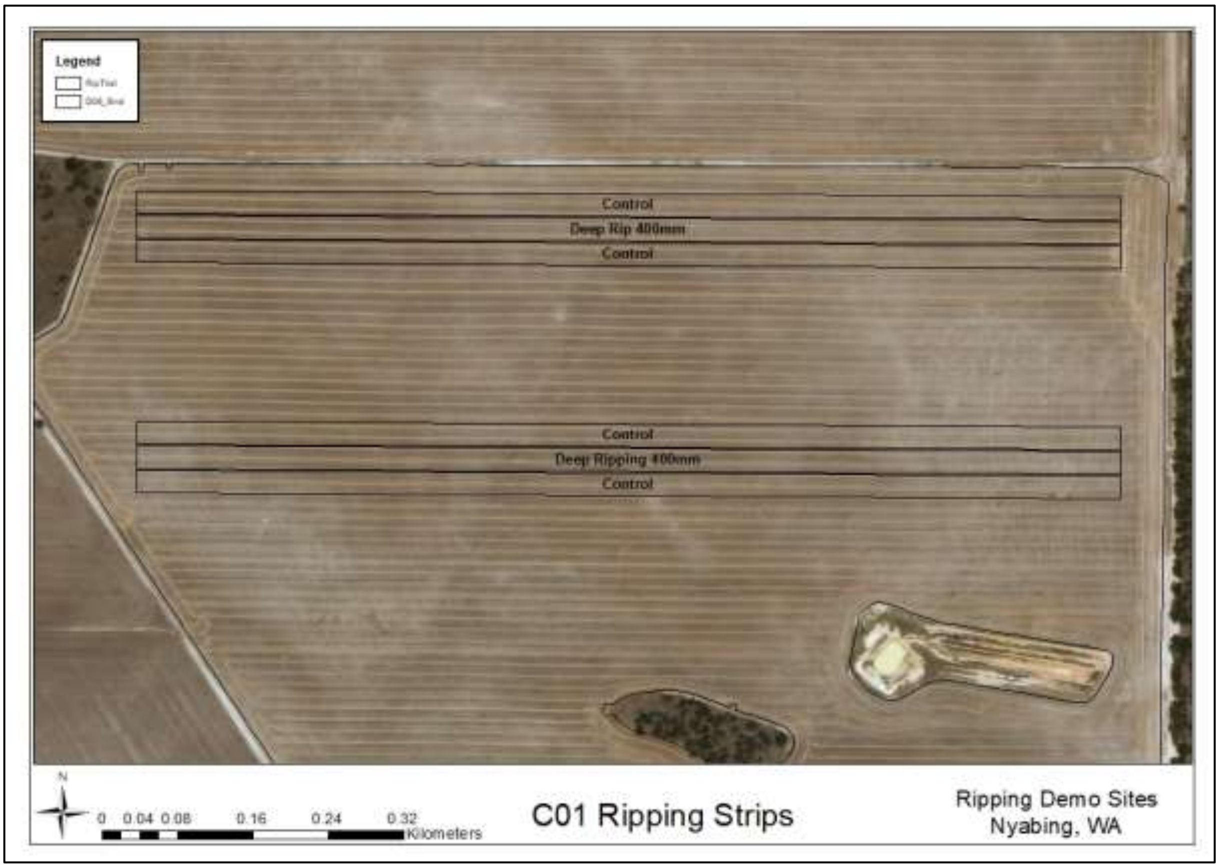


Figure 1: Six deep ripping demonstration sites were established on the Hobley’s farm near Nyabing in 2017, an example of which is shown above. The sites consisted of a 36 metre wide plot ripped at 400mm. Undisturbed ‘Control’ plots allowed yield comparisons to be made.

Soil and plant measurements

A number of soil and plant measurements were collected during the 2017 season in addition to yield. A Rimick CP300 Cone Penetrometer was used to measure soil compaction at 180 locations across the six demonstration sites along each rip and control plot. This was made up of five insertions at 10 locations along each of the two control strips and the ripping strip at each demonstration. Insertion 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 and used to characterise the soil resistance at each location. Crop tiller density (tillers/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

The impact that deep ripping has had on yield cannot be definitely quantified as this is an un-replicated demonstration and the results should only be used as a guide to likely outcomes.

Yield increases were recorded in all ripping demonstration plots when compared to the adjacent control plots and ranged from 44 to 556 kg/ha (Table 1).

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

Ripping Demo ID	Apparent Yield Benefit (kg/ha)
D06	154
C01 North	179
C01 South	218
R09 North	247
R09 South	44
R07	556
Average Benefit	233

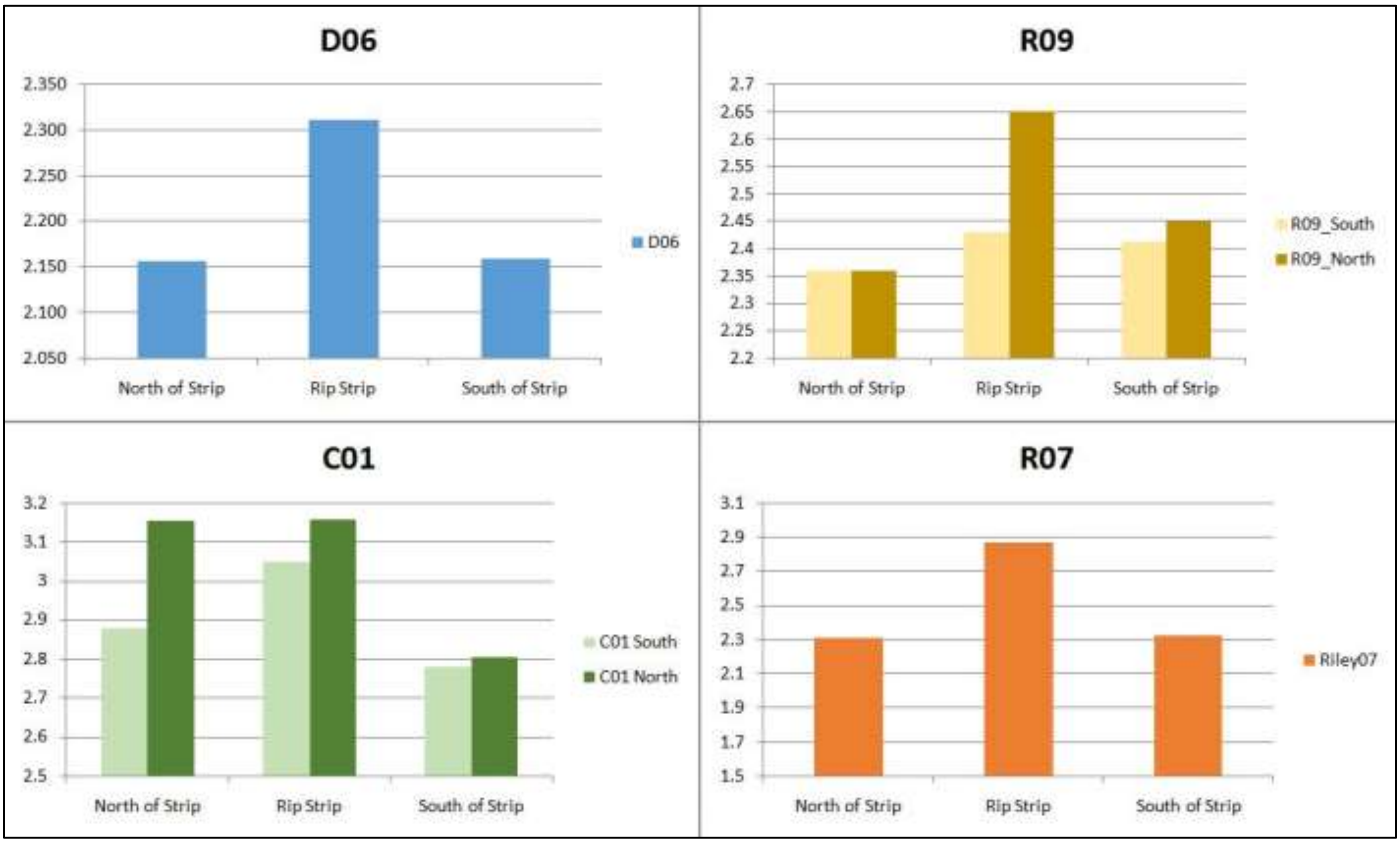


Figure 2: Average crop yield for the deep ripping and control plots showed that deep ripping provided an apparent yield benefits in all sites.

Soil and Plant Measurements

The average soil strength was found to be reduced in the deep ripping plots to a depth of 400mm when compared to the adjacent control plots in all demonstration sites (Figure 3). 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 then increased to levels similar to the control plots. The ripped plots in R09 South and C01 North maintained higher levels of compaction than the other demonstration sites. 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 remove fully remove compaction as a constraint in these areas.

Soil type changes across the ripping plots is thought to explain the variation in soil compaction after ripping and will be examined in the 2018 season.

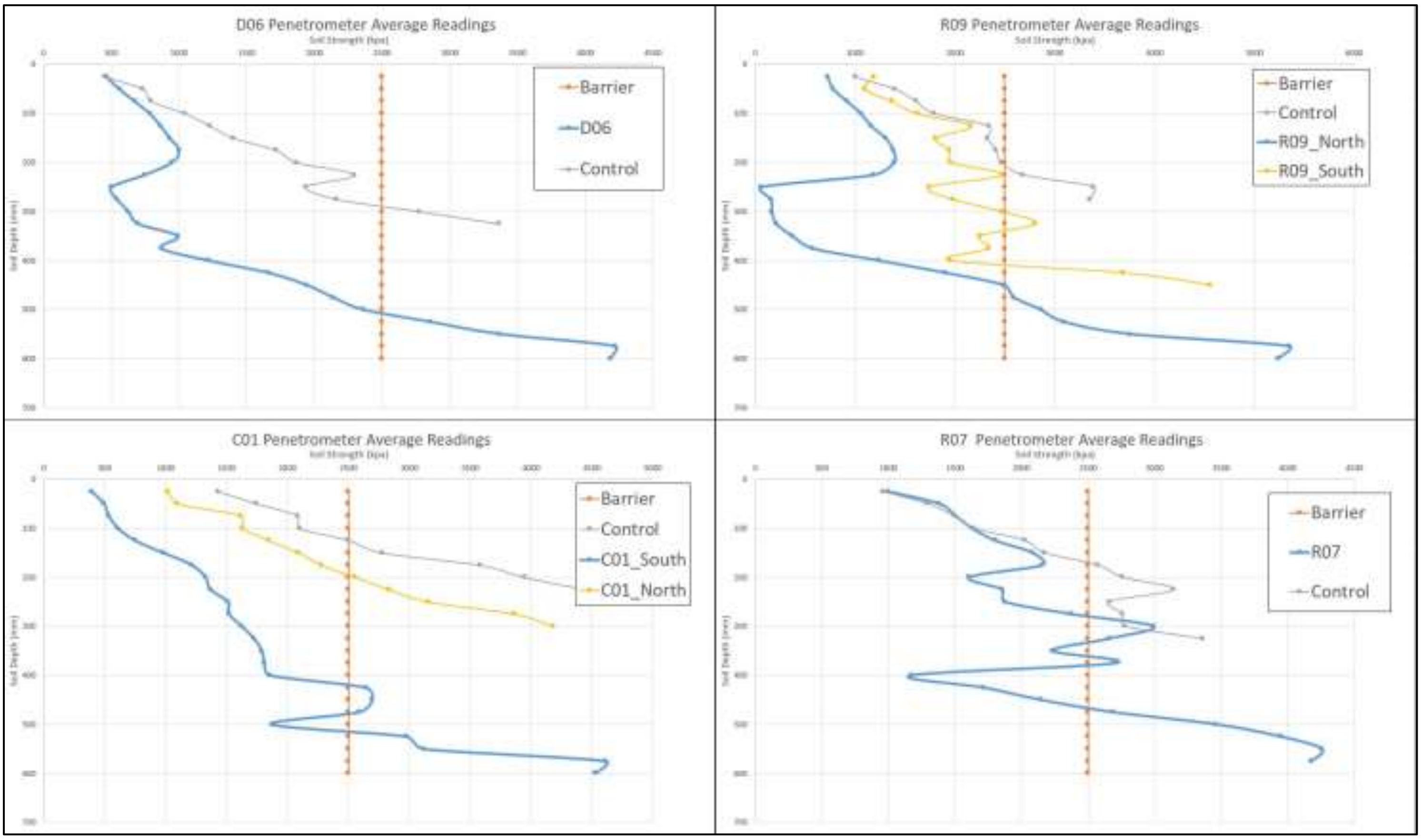


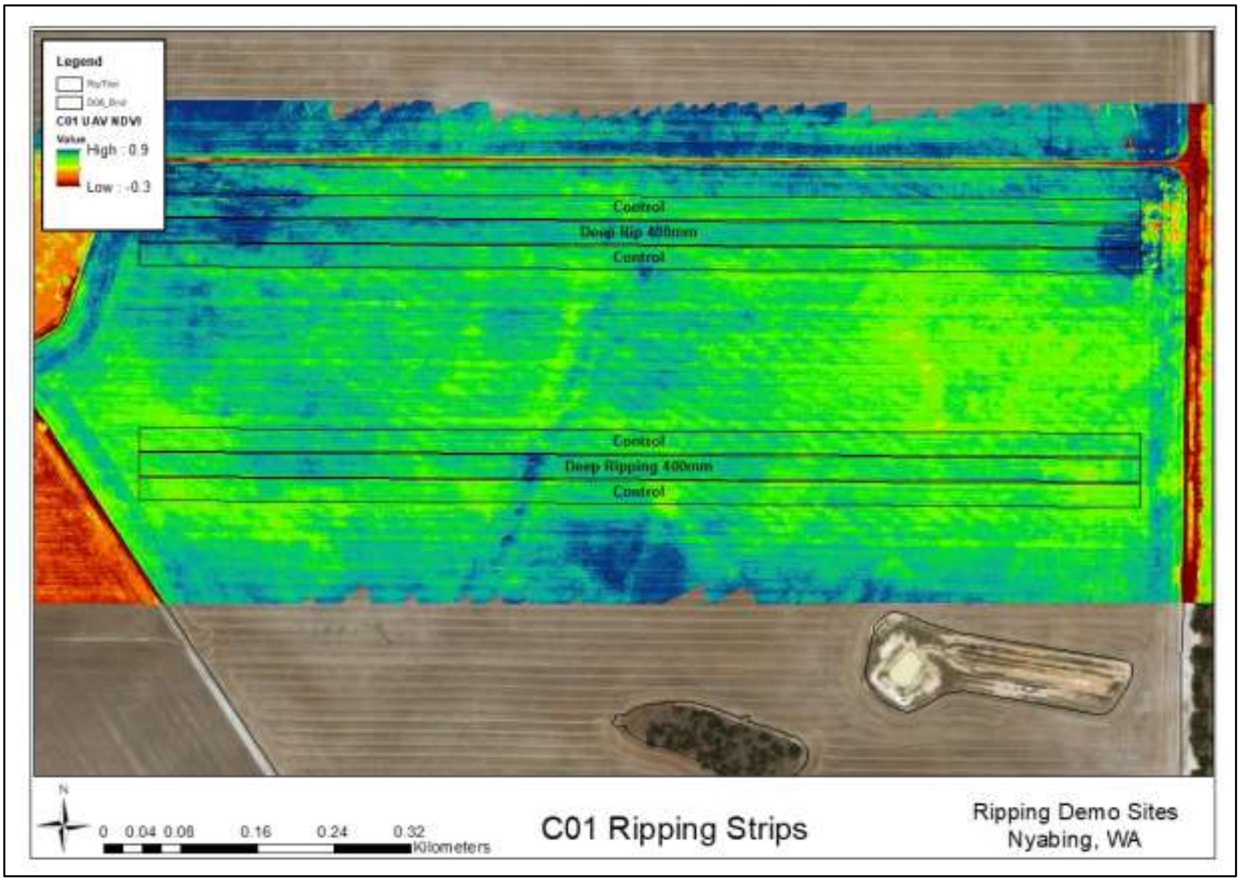
Figure 3: Average soil strength measurements from ripped and control plots as recorded by a cone penetrometer in August 2017.

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 overall 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
D06	384	360
C01 North	402	396
C01 South	445	437
R09 North	389	358
R09 South	337	345
R07	378	369
	389	378

There seemed to be a small visual difference 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). These areas are planned to be visited during the 2018 season to assess the reason for these differences.



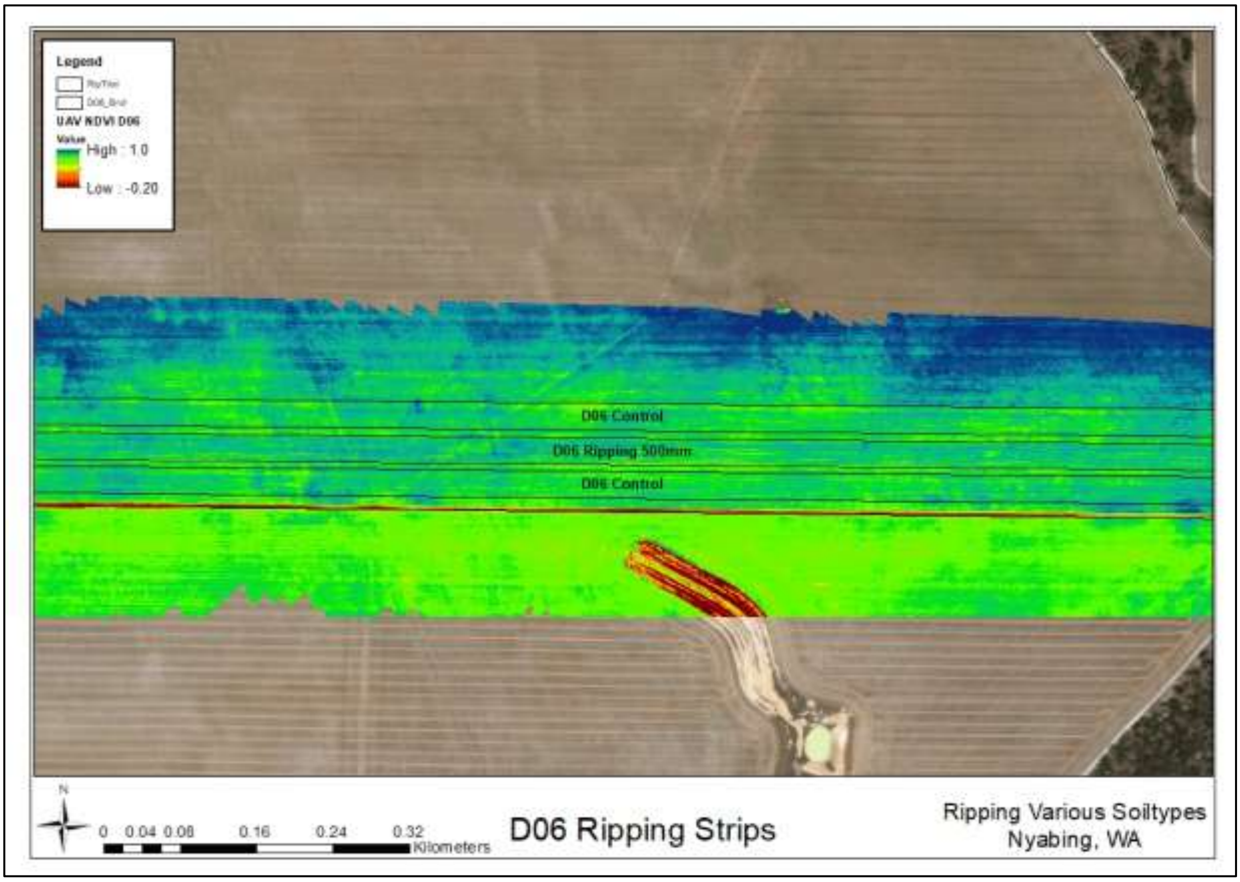


Figure 4: NDVI imagery shows biomass variation across the trial though no measureable difference between treatments

Conclusion

There have been positive yield responses observed since the deep ripping treatments were established in 2017. Ongoing yield increases are likely to have provided a positive return on investment to the farm business. The yield response from the upcoming 2018 season will give an indication as to the longevity of the deep ripping effect and therefore how likely it is an ongoing economic advantage will be realized from the practice.

A detailed economic analysis of the advantage of deep ripping has not yet been carried out at this site though the results of the demonstration encourage further replicated trials to accurately quantify the benefits of deep ripping in the area. It is thought that the positive yield increases seen in the trial would have provided a positive return on investment though actual costs of the treatment and prices of crops in each season would need to be examined.

The yield responses to deep ripping will continue to be monitored over the 2018 season to see if the treatment effects continue. The longevity of the treatment effect will determine how cost effective deep ripping is in this environment and on these soil types. The yield results from the 2018 season will be important to quantify how long the ripping effect seen here will last.

Acknowledgments

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