Assessing the yield response to deep ripping near Muradup, Western Australia.

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Key messages

1. Deep ripping provided a 260kg/ha yield increase in barley in 2016,
2. Deeper ripping and the use of inclusion plates did not improve barley yield at this site,

Aims

To assess the impact of deep ripping on crop yield in a gravelly loam soil type near Muradup, WA.

Method

A replicated trial was established approximately 20kms north west of Kojonup by farmer Simon Zacher, Southern DIRT and DPIRD in 2016 to assess the effect of deep ripping. Replicated plots ripped to 350mm with and without inclusion plates and at 550mm without inclusion plates were setup along with additional cultivation treatments added to the edge of the trial. These additional treatments included a scarifier working at 250mm, offset discs working at 150mm and a Heliripper working at 600mm,aimed to provide a contrast against the other treatments (Figure 1). These additional treatments were not replicated though 'Nil' strips were left to allow a comparison against the undisturbed plots (Table 1).

In total 23 plots, 12m wide and 400m long, were established which aligned with existing controlled traffic lines. Six undisturbed 'Nil' plots were distributed across the trial though not in each replication.

All sites were sown with the growers seeding machinery as part of the normal seeding operations. The paddock was sown to barley in 2016 and canola in 2017. Harvesting of the trial plots was carried out separate to the surrounding crop using the grower's harvester and recorded using a weight trailer.

Table 1:Ripping treatments and number of plots at the trial on Simon Zachers farm near Muradup, WA.

Treatment	No of plots
Nil	6
Ripper _550mm	3
Ripper_350mm	3
Ripper_350mm+Slotting	4
Heliripper_600mm	3
Offset Disk_150mm	2
Scarifier_250mm	2

Soil and plant measurements

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

Soil penetration resistance using a digital cone penetrometer was measured twice in each plot and used to assess differences in soil compaction. Where possible, the rip line was located and five insertions were recorded at each site with the average of these insertions used to characterise the soil resistance at each location.

Plant density (plants/m^2) and soil pH analysis (pH analysis in 10cm intervals to 50cm) was also carried out at each soil penetrometer recording site to assess crop establishment differences and subsurface acidity.

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.

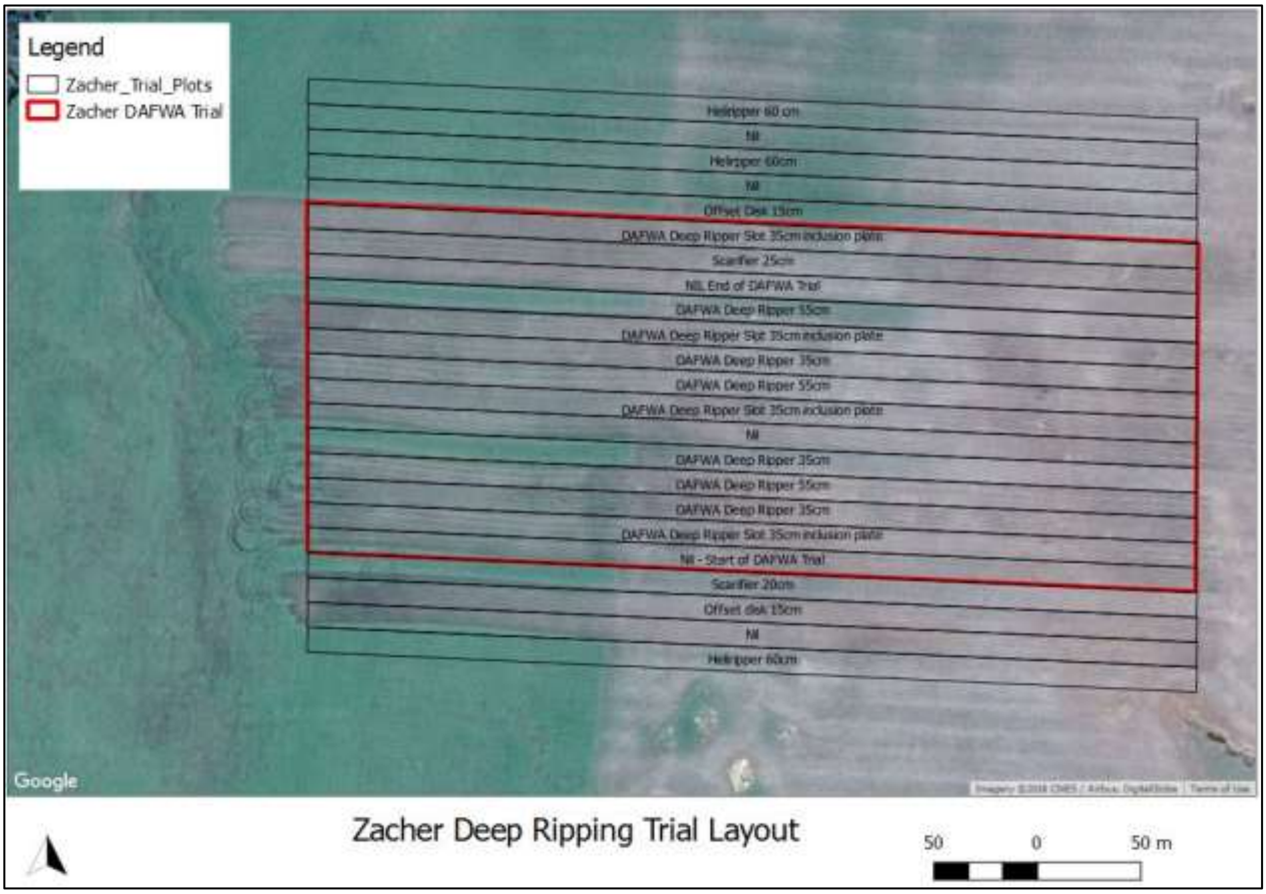

Figure 1: A replicated deep ripping trial (plots in red border) was established on the Zacher farm near Muradup in 2016. Additional cultivation treatments were added at the edge of the trial to compare the effect of scarifier, offset disc and Heliripper on crop yield.

Results and Discussion

Crop Yield

Comparison of the annual yield response has been split into two groups to reflect the treatments that are replicated and those that are not for both the 2016 and 2017 seasons.

A significant yield difference was observed only in the 350mm rip treatment in 2016 which gave a 260kg/ha increase (lsd = 204kg/ha) over the Nil plots. There was a non-significant yield difference of approximately 200kg/ha for the other ripping treatments in 2016. The offset disc and scarifier treatments indicated a yield increase over the Nil plots and the Heliripper suggested a yield decrease, though the significance of these trends cannot be verified and are likely misleading.

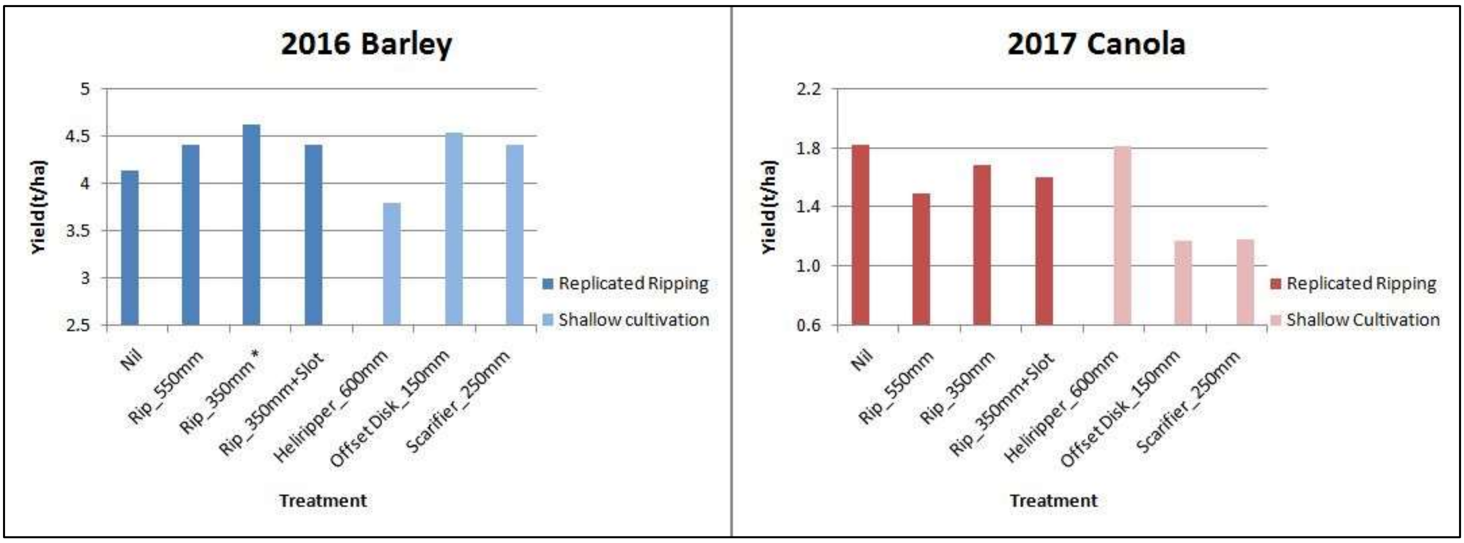

Figure 2: Average crop yield for the deep ripping and control plots showed that deep ripping to 350mm provided a yield benefit in 2016. Significance is represented by the * in the treatment label on the x axis.

Yield data in 2017 showed an overall decrease in yield in all ripping treatments when compared to the Nil treatment except in the unreplicated Heliripper treatment which had a similar yield.

Windy conditions prior to harvesting the trial resulted in pod shatter and an estimated 50% loss of grain. An un-even application of in season nitrogen was found using the UAV NDVI imagery (Figure 3) and unfortunately both of these issues invalidate the 2017 yield results.

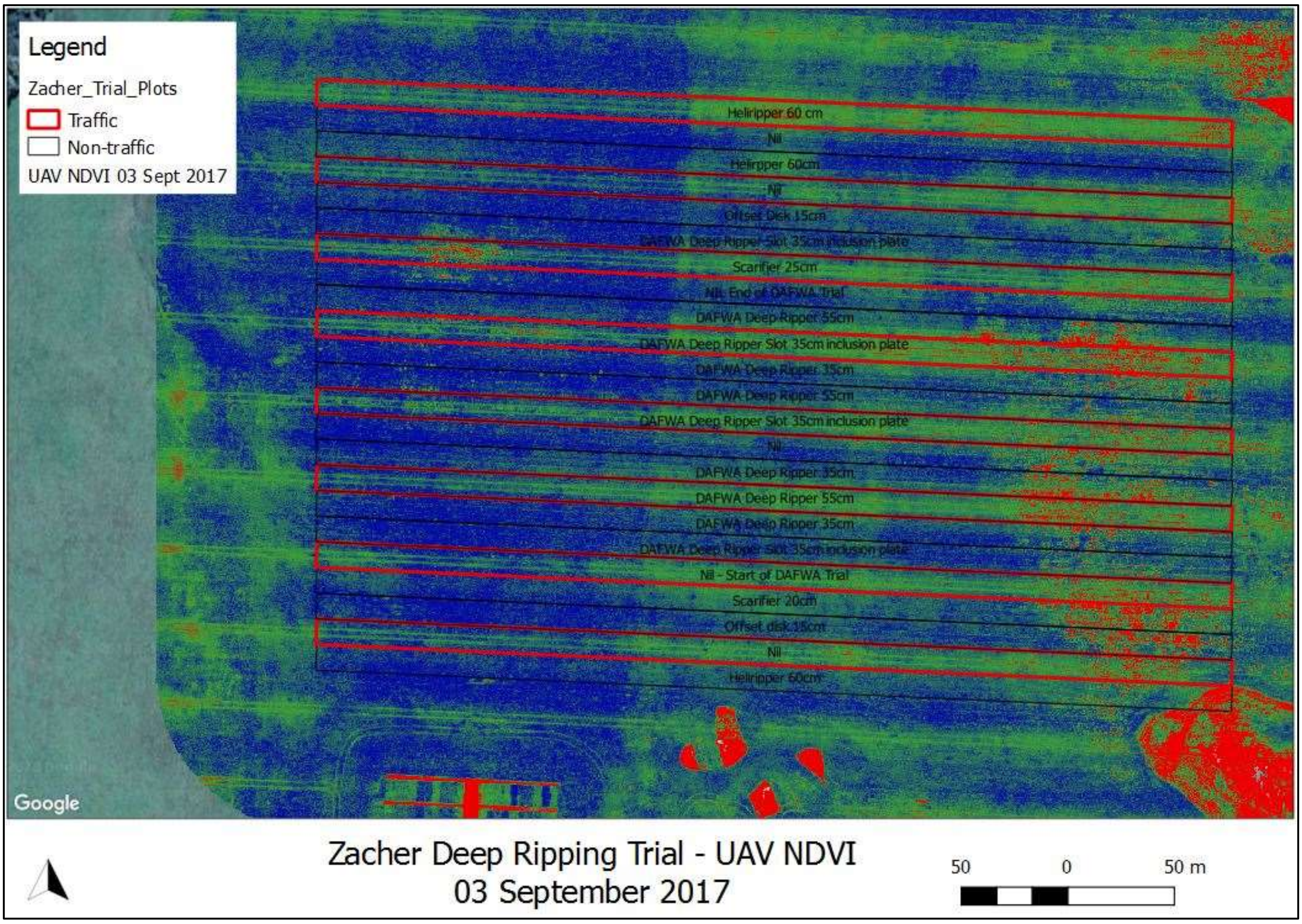

Figure 3: UAV NDVI imagery captured on 03 September 2017 shows variations in biomass across the trial. The influence of gravel soiltype on biomass can be seen on the eastern end and the influence of past merged paddock can be seen on the western end.

Soil and Plant Measurements

Soil coring across the trial site confirmed that loamy sand over gravelly clay and sandy gravel loam over gravel were the two soil types present (Figure 4). The sandy gravel was located in the eastern end of the trial and this area was excluded from all analysis.

A Rimick CP300 Cone Penetrometer was used to measure soil compaction at 46 locations across the trial. This was made up of five insertions at 2 locations along each plot. 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.

No measurements were collected from the shallow cultivation treatments or below 600mm in the other treatments. Many locations had too much gravel to measure compaction accurately and were discarded from the data set.

Figure 4: Soil types found at the site were either a loamy sandy over gravelly clay (left) or sandy gravel loam over gravel (right).

The average soil strength was found to be reduced in the deep ripping plots to the depth of working then increased (Figure 5). The control plots consistently reached 2500kpa between 150 – 200mm soil depth and increased to peak at 4500-5000kpa at 400mm depth. Deep ripping plots generally maintained compaction levels below 2500kpa to 400mm depth then increased to levels similar to the control plots. Previous research has found 2500kpa to be the compaction level where plant root growth begins to be inhibited. This indicates that the deep ripping did not remove compaction as a constraint below 400m across the trial site.

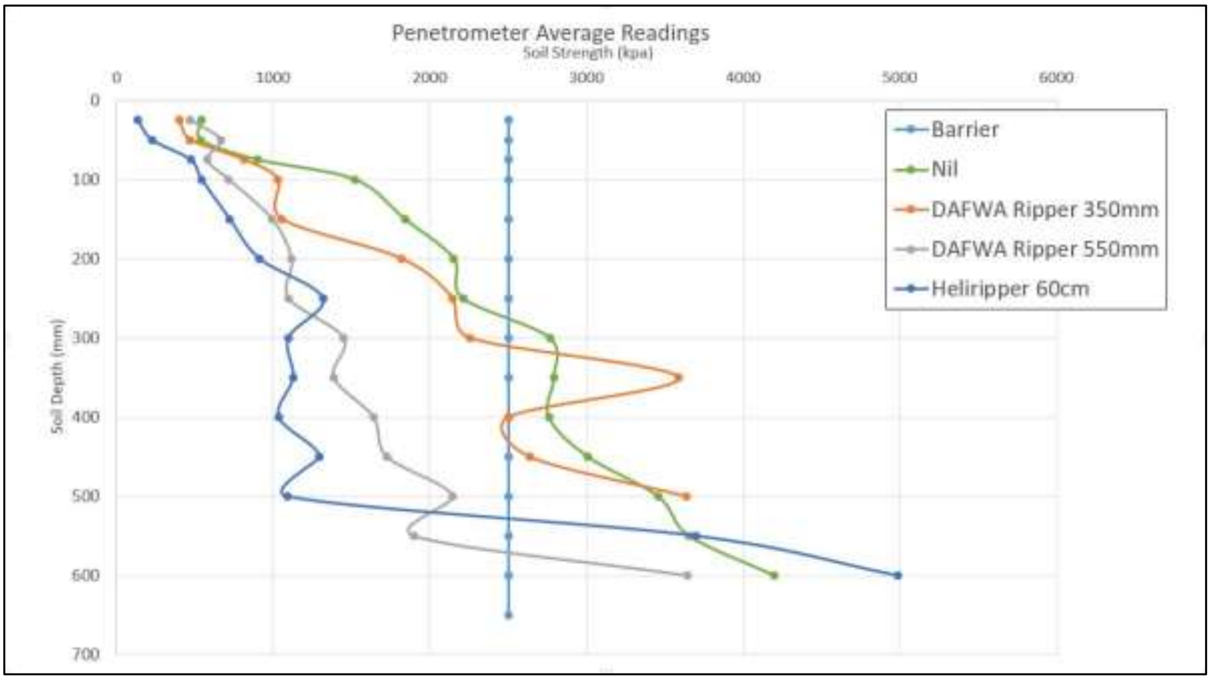

Figure 5: Average soil strength measurements from ripped and control plots as recorded by a cone penetrometer in August 2017.

Plant density was measured by counting canola stems along a 0.3m section of crop row at each penetrometer recording site after harvest and showed no difference in plant establishment or plant density across the trial except in the sandy gravel loam which had a reduction in plant numbers and was removed from the trial. This reduction in plant density and biomass can be seen in the eastern end of the trial and is visible in Figures 3 and 6.

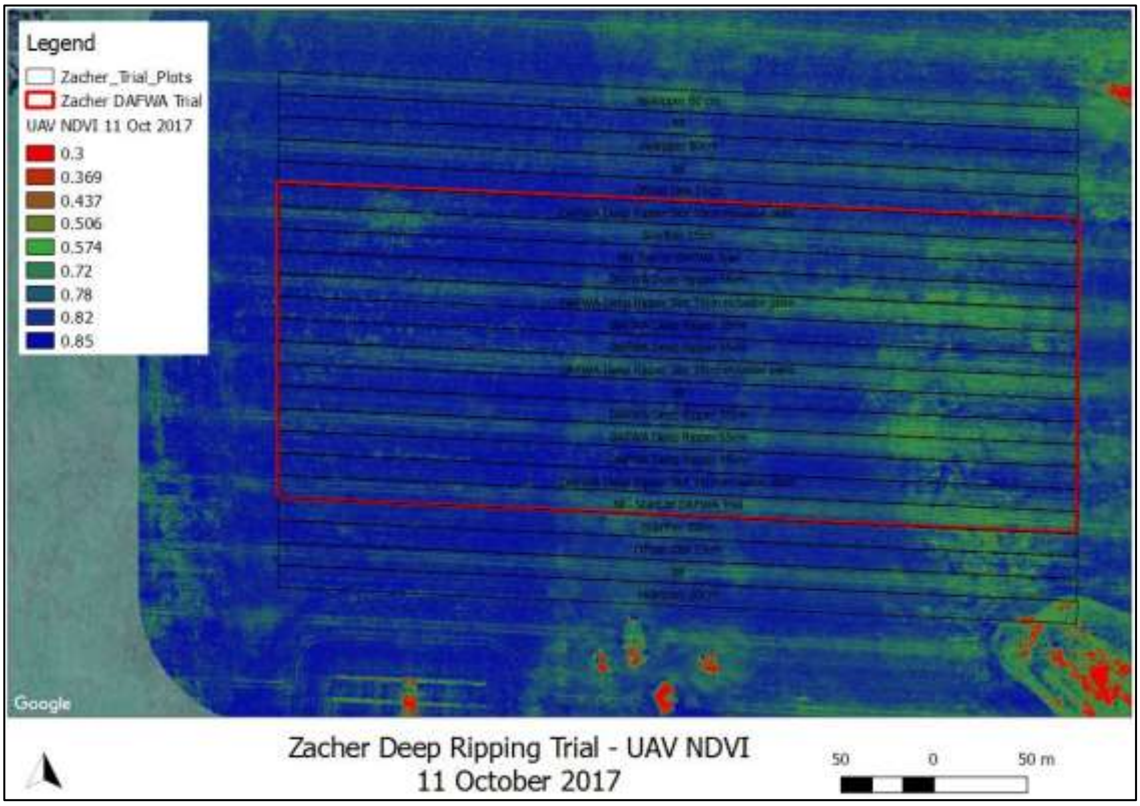

Figure 6: UAV NDVI imagery captured 11 October 2017 shows influence of merged paddock on the western end of the trial and gravel soil type on the eastern end.

UAV NDVI was flown on 03 September and 11 October 2017 and picked up biomass variation caused by two paddocks being merged a number of years before the trial was established. This variation is not seen when on the ground in the paddock.

Returns of Deep Ripping

A detailed economic analysis of the advantage of deep ripping has not yet been carried out at this site though the results of the trial encourage further replicated trials to accurately quantify the benefits of deep ripping in the area.

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.

Conclusion

Ongoing yield increases, like the positive result from barley in 2016, 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 that an ongoing economic advantage will be realized from the practice.

Acknowledgments

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