Deep ripping demonstration on varying soil types near South Stirling, Western Australia.

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Key messages

1. Yield increases from deep ripping ranged from 220 to 750 kg/ha.
2. Deep ripping demonstrations provide a tool to assess possible yield gains across various soil types.
3. Replicated trials are needed to validate the yield increases seen at this demonstration site.

Aims

To assess the impact of deep ripping on barley and canola yield on sand over gravel and deep sand soil types in the South Stirling area of WA.

Method

Trial Details

A deep ripping demonstration was established in 2016 near South Stirling, approximately 60km north east of Albany, WA . Two 24 metre wide demonstration strips were setup using a Heliripper, one to a depth of 350mm and the other to a depth of 700mm. Undisturbed 'Nil' plots were left around the treatment strips so yield differences could be assessed. The trial is spread across two distinct soil types; a shallow sandy gravel over laterite on the western end and a clayed deep sand to the east.

The paddock was sown to barley in 2016 and canola in 2017. A weigh trailer was used to record yield data from both gravel and sand ends of the demonstration in 2016 though yield was only available for the gravel end in 2017. Yield differences for each ripping treatment were estimated by comparing the yield from the treatment plot against the average of the two adjacent Nil plots.

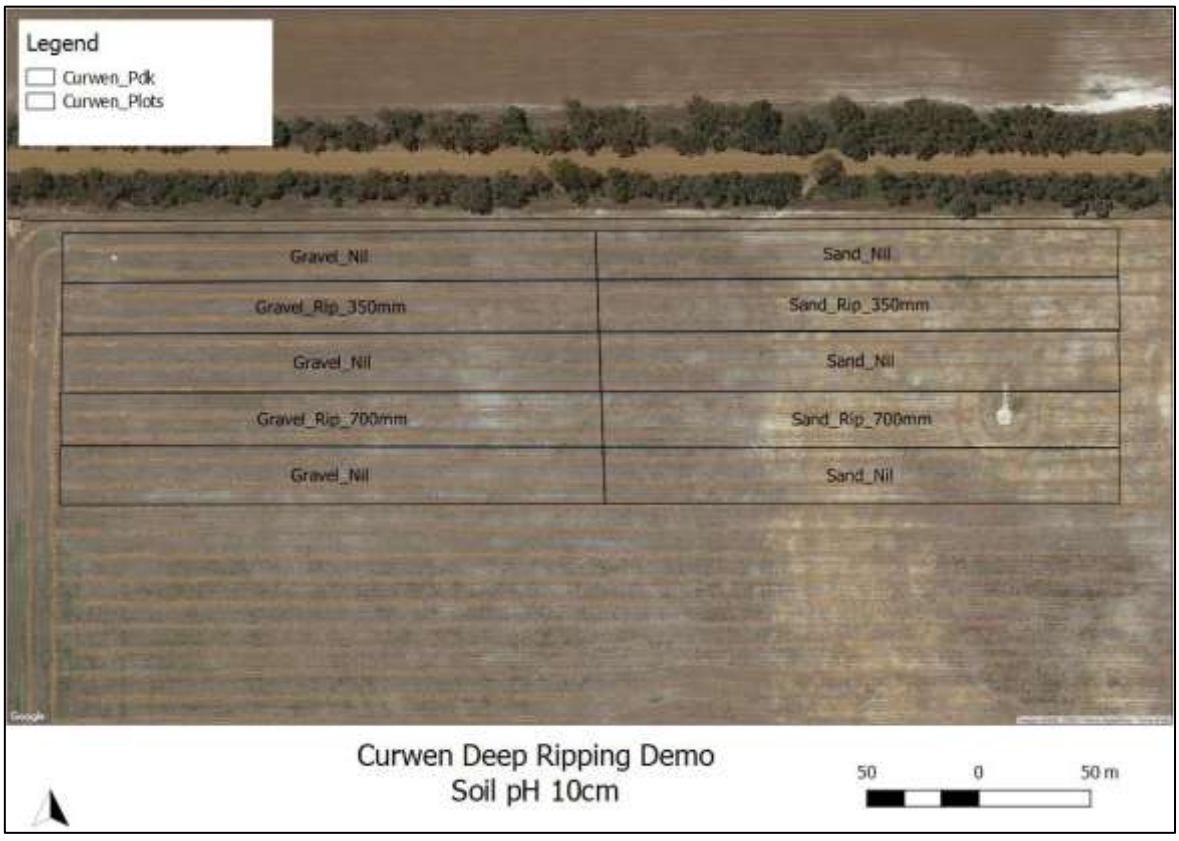

Figure 1: A deep ripping demonstration site on Reece Curwen's farm near South Stirling was established in 2016. The trial consisted of two ripping treatments at 350mm and 700mm in 24 metre wide plots. Undisturbed 'Nil' plots allowed yield comparisons to be made in barley and canola crops in 2016 and 2017.

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 assess if subsurface acidity existed. 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 both ripping treatments and across soil types in barley (2016) and canola (2017) (Figure 2). Unfortunately the yield data on the deep sand soil type of the demonstration could not be collected for canola in 2017.

2016 Barley Yield

The 350mm ripping treatment in the gravel soil type provided the largest apparent yield increase of 750kg/ha when compared with the adjacent Nil strips. The 700mm ripping treatment in the gravel recorded a 370 kg/ha yield increase over the adjacent Nil strips. Yield increases were smaller in the deep sand soil type with the 700mm ripping treatment showing a 220 kg/ha yield increase and the 350mm ripping treatment showing a 220 kg/ha yield increase.

2017 Canola Yield

The 350mm ripping treatment in the gravel soil type recorded the largest yield increase again in 2017 of 280 kg/ha more canola than the adjacent nil plots. The 700mm plot in the gravel soil type showed a 110kg/ha yield increase when compared to the Nil plots.

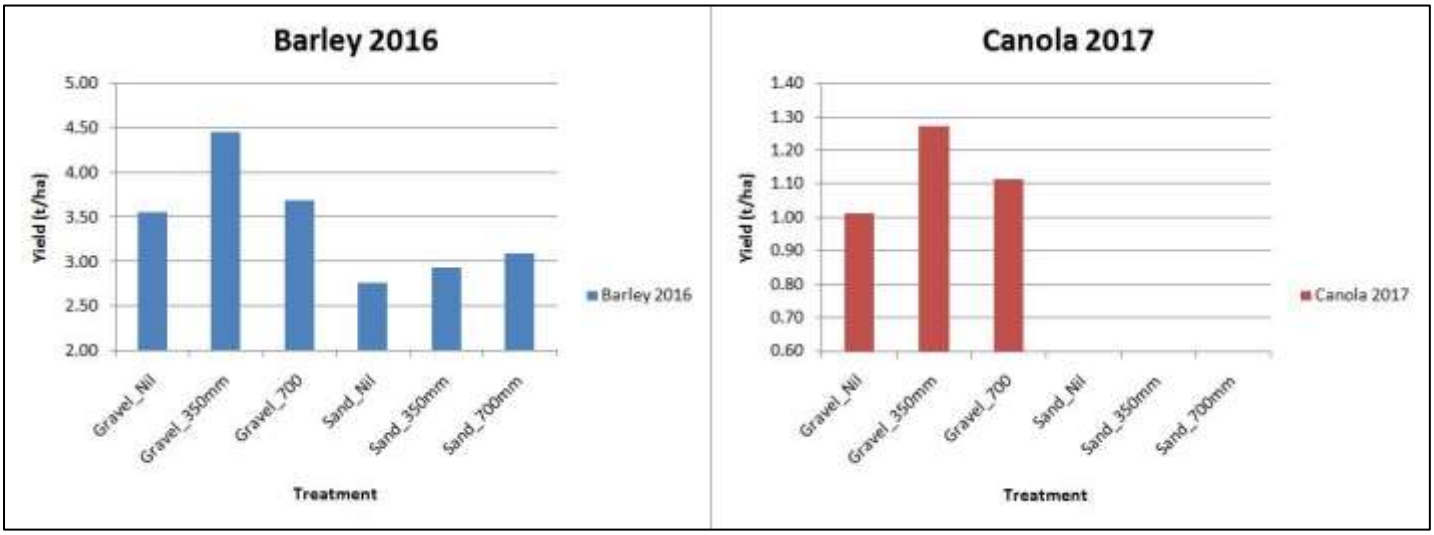

Figure 2: Average crop yield for the deep ripping and control plots showed that deep ripping provided an apparent yield benefits in barley (2016) and in canola (2017).

Soil and Plant Measurements

Soil coring across the trial site confirmed that shallow sandy gravel over literate and clayed deep sand were the two soil types present (Figure 3). All soil penetrometer insertions in the pale sand over gravel soil type were discarded due to the gravel interfering with the readings though all other insertions were kept.

A Rimick CP300 Cone Penetrometer was used to measure soil compaction at 16 locations across the trial site and found there were differences in soil strength after deep ripping (Figure 4a). Soil compaction in the undisturbed plots increased

Figure 3: Soil types found at the site were either pale sand over gravel (left) or deep pale sand (right).

steadily from the surface to peak at around 5000kpa at approximately 600mm. The 350mm rip treatment showed a reduction in soil compaction to approximately 300mm and then increased to peak and maintain 5000kpa at 600mm. The 700mm rip treatment was less compact to 600mm though soil strength levels greater than 2500kpa were still observed. Previous research has found 2500kpa to be the compaction level where plant root growth begins to be inhibited so it is expected that the demonstration site will experience compaction as a soil constraint and may help explain yield differences observed.

Soil pH analysis showed large variations in soil pH across the site with almost a whole pH unit range being observed in each 10cm soil layer. Soil pH variation still existed within the soil type groups highlighting the natural variation in soils and impact of claying the soil surface (Figure 4b). Overall, soil pH fell well below pH targets of 5.5 in the topsoil and 4.8 in the subsurface. It is expected that subsurface soil acidity will be restricting root growth at the site and will be a severe soil constraint to the barley and canola crops which were planted.

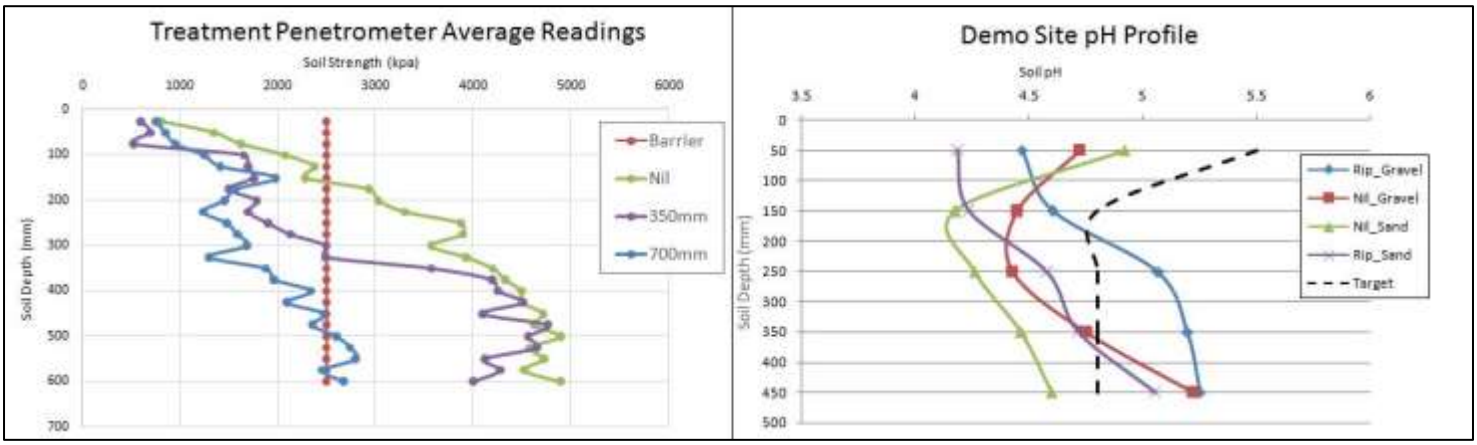

Figure 4a and 4b: Average soil strength measurements from ripped and control plots as recorded by a cone penetrometer in August 2017 and soil pH values collected in February 2018.

Plant counts showed no overall difference in density between the treatments though visual difference in plant biomass was recorded. The imagery captured by the UAV shows large variation in NDVI across the trial site (Figure 5) and shows variation in plant biomass rather than plants/m2. The imagery suggests that there may be a reduction in biomass in the 700mm ripping plot in the sand soil type though this cannot be quantified in the plant count data.

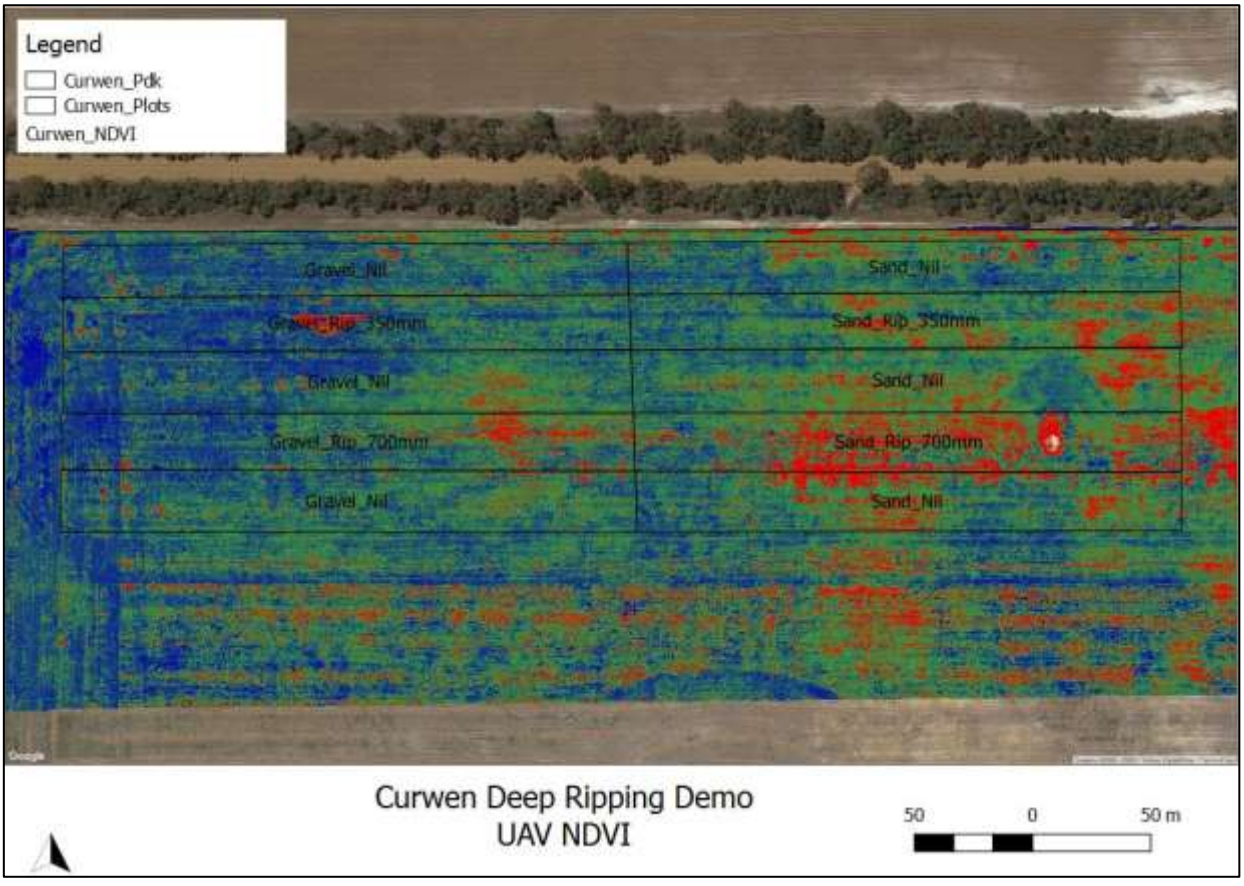

Figure 5: NDVI imagery shows biomass variation across the trial though no measureable difference between treatments

Returns of Deep Ripping

A detailed economic analysis of the advantage of deep ripping cannot be 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.

Conclusion

There have been positive yield responses seen in each season since the deep ripping treatments were established in 2016. The cumulative yield increase is 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 if an economic response is ongoing.

Acknowledgments

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