Assessing the yield response to deep ripping over two soil types near Beverley, Western Australia.

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Key messages

1. 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 in different soil types and production zones near Beverley, WA.

Method

An 11ha section of 50ha paddock was ripped with a 6 metre Agrowplow at a 500mm working depth in January 2017 (Figure 1). The ripped area covers varying soil types though it is dominated by a deep coarse sand and sand over loamy clay. Cropping production zones are defined by these soil types with the deep sandy area having low production when compared to the sand over loamy clay.

The paddock was sown to wheat with the growers machinery 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. The ripped area was not harvested separately though the yield data from the ripped and un-ripped areas was recorded separately in the yield monitor.

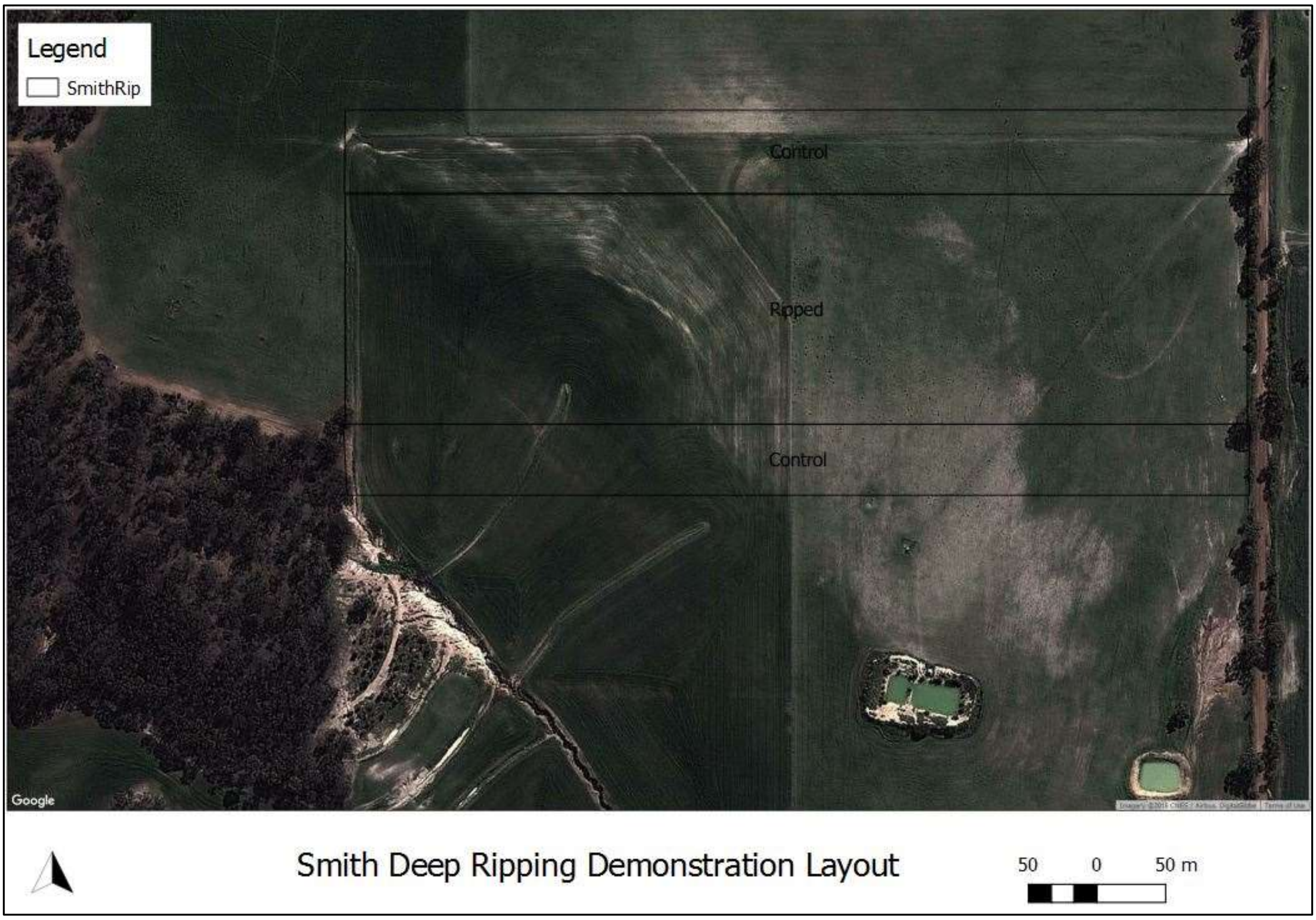

Figure 1: An 11ha area was ripped in block across a deep sand and sand over loamy clay soil types.

Yield differences between ripping and un-ripped areas could only be made along the north and south edge of the ripped area. Yield data from the two closest header passes to the ripped area boundary, both inside and outside the ripped area, were initially compared along the entire length of the boundary (Figure 2).

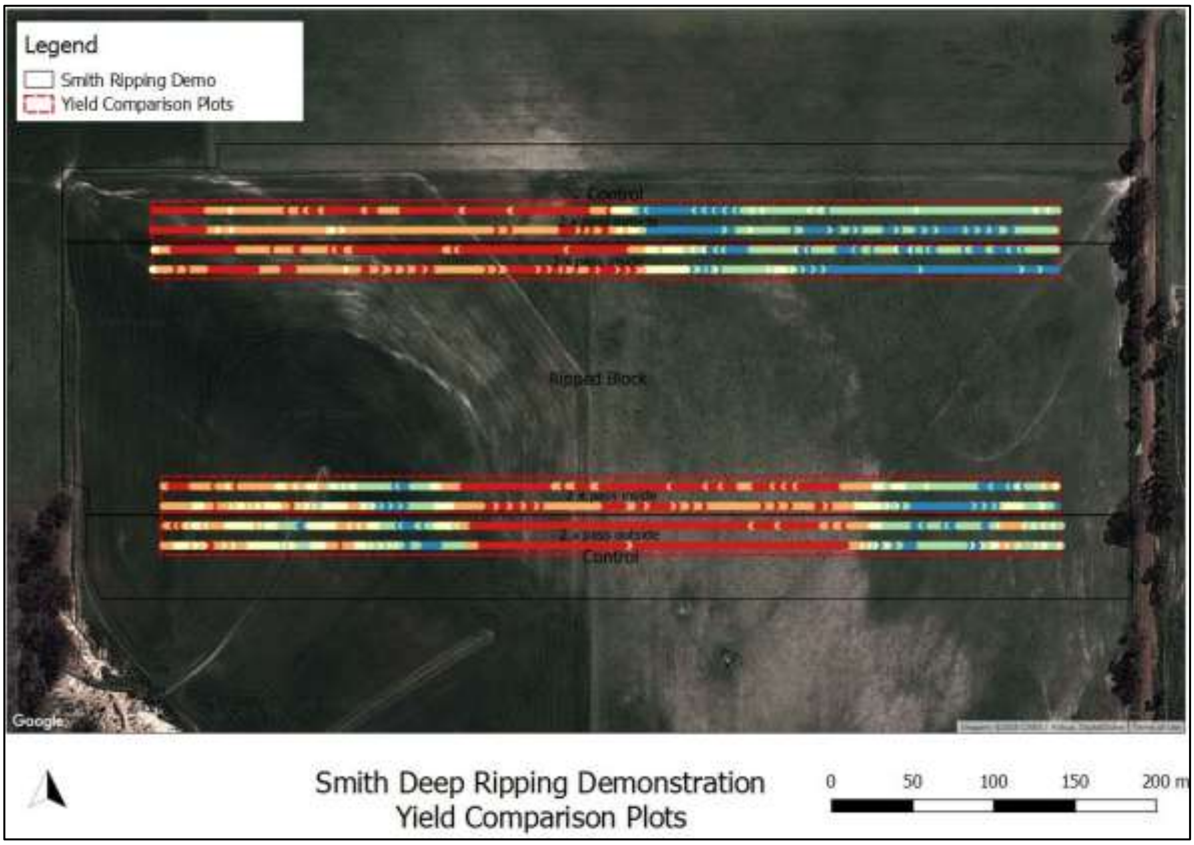

Figure 2: The two closest header passes to the treatment edge were used to compare yield differences between the ripped and un-ripped area.

The same yield data was then split into areas of Low, Medium or High production zones and yield differences re-examined within each zone (Figure 3).

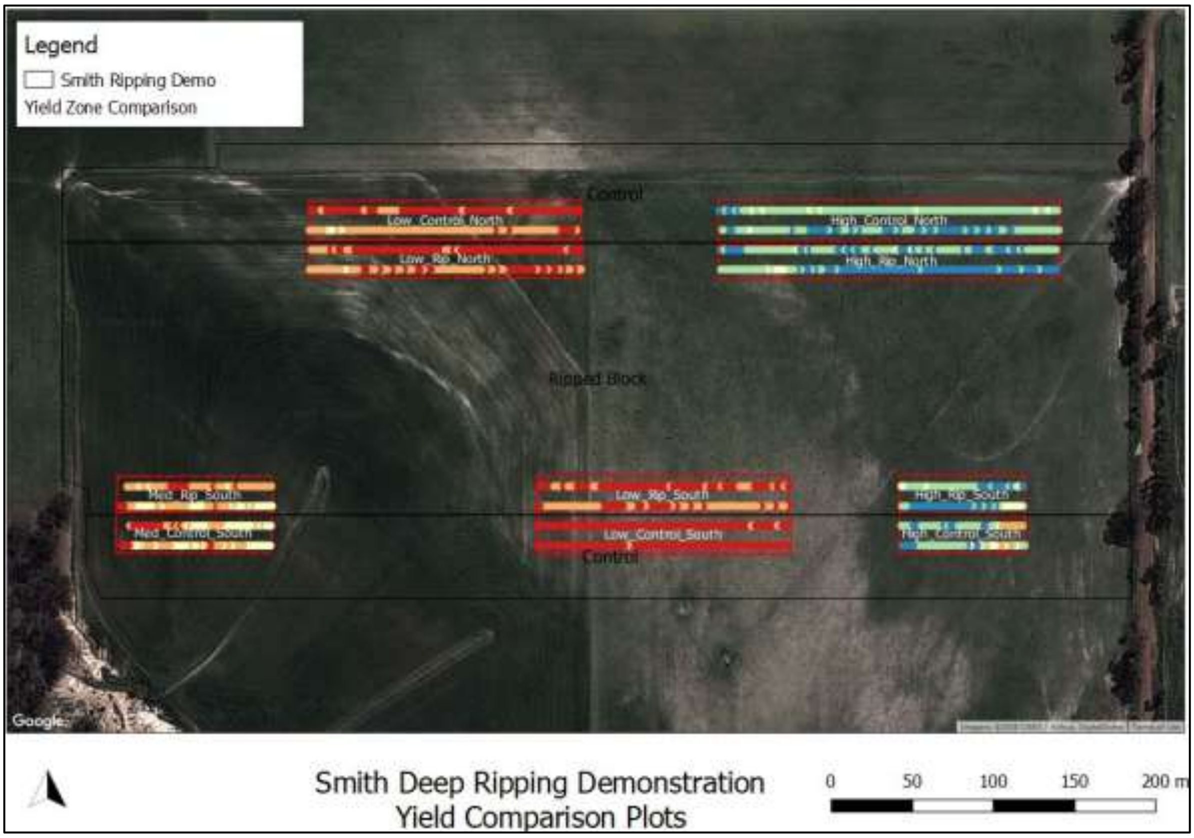

Figure 3: Yield data was split into production zones and differences compared.

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 at multiple locations along each rip and control plot and used to assess differences in soil compaction. A Rimick CP300 Cone Penetrometer was used to measure soil compaction at 48 locations across the demonstration site. This was made up of five insertions at 12 locations along each of the northern and southern treatment edges. Insertions locations were randomly chosen outside the ripped area though the ripping line was found and measurements taken from within the rip line for the ripped section with the average of these insertions used to characterise the soil resistance at each location.

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 be used as a guide to likely outcomes.

Yield differences were initially examined along the entire length of the ripped boundary and mixed yield differences were observed. A yield loss of 140kg/ha was recorded along the northern edge of the ripped area while a 70kg/ha yield gain was seen along the southern edge (Figure 4). The overall yield was approximately 300kg/ha higher along the northern edge of the ripped area and highlights the different soil type found in this part of the paddock.

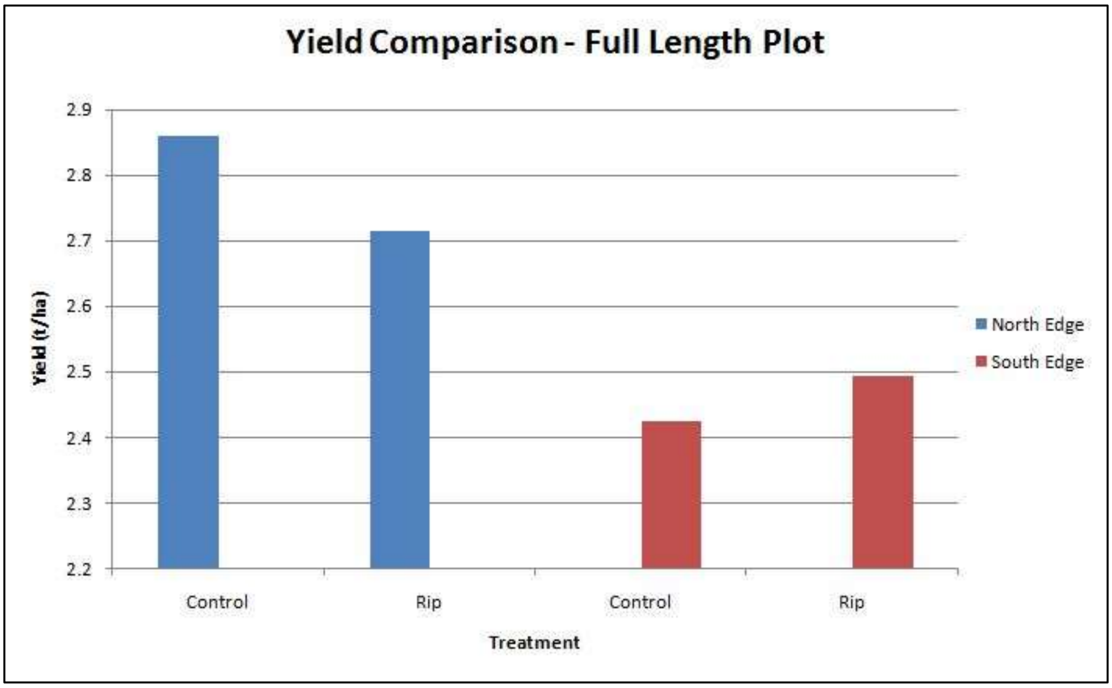

Figure 4: Yield comparison between the ripped and un-ripped area shown mixed results when examining the entire plot length.

Yield differences between production zones along the ripped area boundary were next examined (Figure 5). This showed that ripping was likely to increase yield in the high production zones with a 270kg/ha and 400 kg/ha benefit recorded in the ripped plots. A 40kg/ha decrease in yield was seen in the medium production zone and a similar 140kg/ha decrease in the northern low production zone was recorded. The low production zone on the southern edge saw a 340kg/ha yield benefit (Figure 5). High production zone was defined by the sand over loamy clay soil type and indicates that positive yield responses to ripping were only occurring in this soil type though more work needs to be undertaken to determine where positive yield increases are likely to be realised.

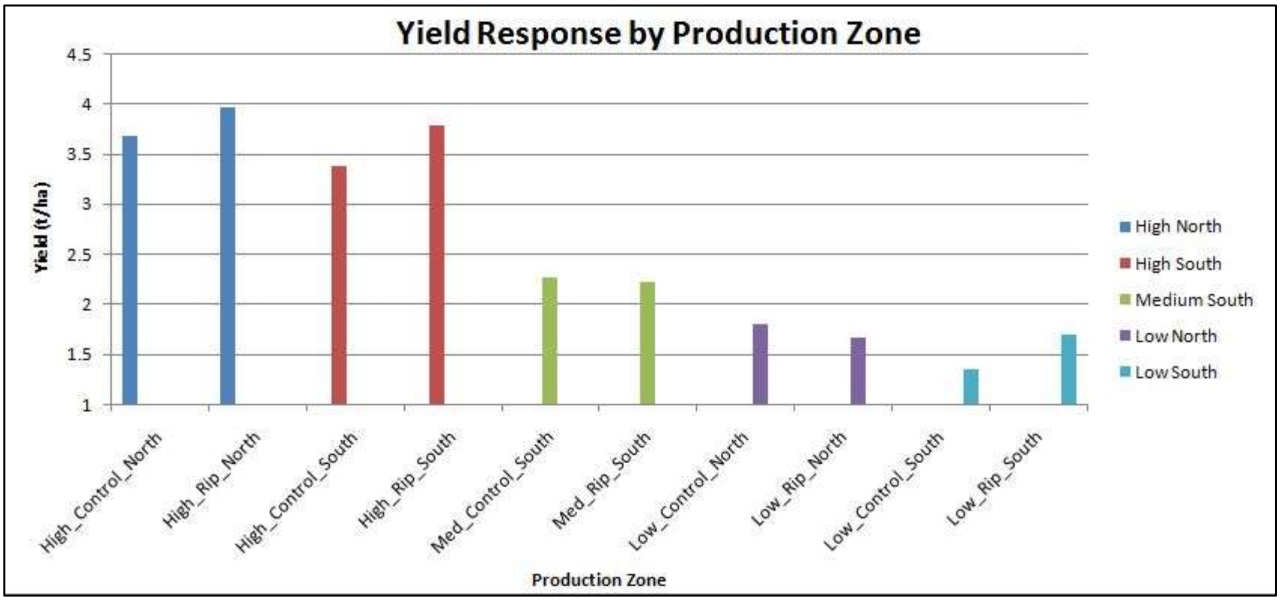

Figure 5: Yield differences in varying production zones where observed at the site.

Soil and Plant Measurements

The average soil strength was found to be reduced in the deep ripping when compared to the adjacent un-ripped soil (Figure 6). The control plots consistently reached 2500kpa between 250 – 300mm soil depth and increased to peak at 4000kpa at 400mm.

The data indicates that there is a natural reduction in compaction in soil deeper than 400mm as the soil strength reduces to just above 2500kpa between 400-600mm. Deep ripping plots generally maintained compaction levels below 2500kpa to 400mm depth then increased to levels between2500-300kpa to 600mm.

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.

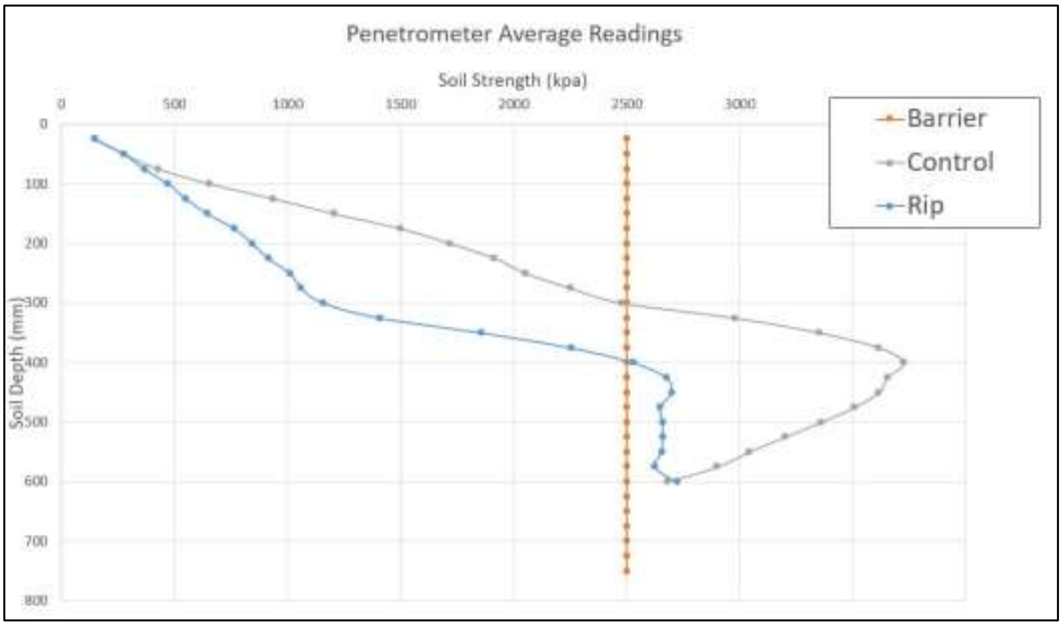

Figure 6: Average soil strength measurements from ripped and control plots as recorded by a cone penetrometer in August 2017.

Plant tiller density was measured by counting tillers along a 0.5m section of crop row at each penetrometer recording and showed very consistent plant establishment though tiller density was much reduced in the deep sand soil type (Figure 7).

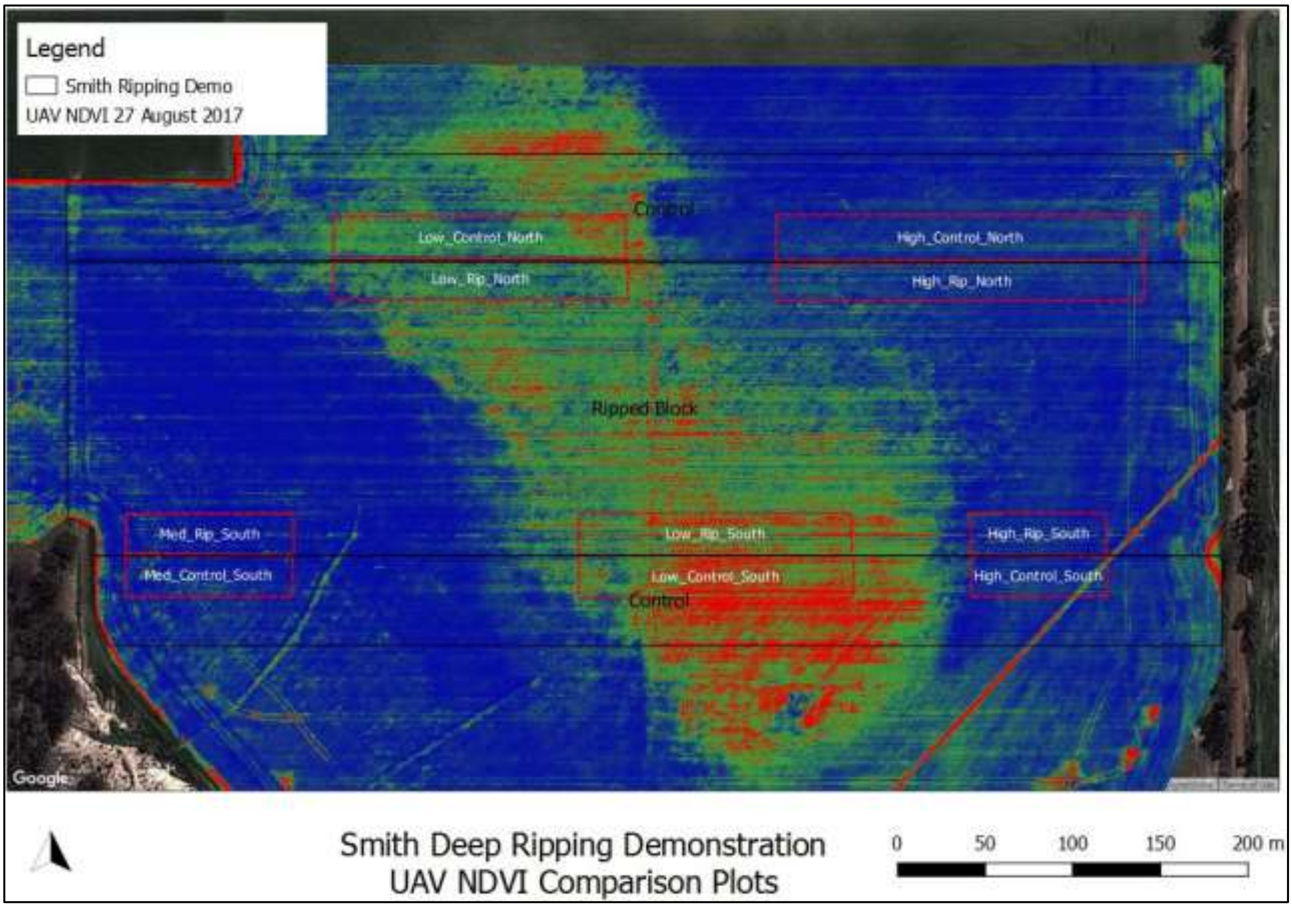

Figure 7: UAV NDVI captured 27 August 2017 shows large variation in crop biomass. Soil type is thought to be the main driver of production at this site

There seemed to be only small visual differences in plant greenness in the boundary of ripped and un-ripped strips throughout the season though it was not consistent along the length of the plots. The imagery captured by the UAV shows a large variation in biomass across the site though only small differences in NDVI between the plots (Figure 7). These areas are planned to be visited during the 2018 season to assess the reason for these differences.

Conclusion

There have been mixed yield responses seen in the soil types ripped at this site 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 marginal positive yield increases seen in high production zones 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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