Assessing the yield response to deep ripping over three soil types near Beverley, Western Australia. 2018 Harvest Update

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Key messages

1. Soil type was found to be the main factor in achieving a positive yield response
2. Deep ripping increased yield in wheat (335kg/ha) and barley (272kg/ha) in sand over shallow loamy clay and deep sand soil type
3. No difference or a decrease in yield was observed in the sand over deep gravel clay.
4. Ripping trials such as this can help determine which soil types across the farm are likely to provide an economic response to deep ripping.

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 a 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, a sand over deeper gravelly clay and a sand over shallow loamy clay. Cropping production zones are defined by these soil types with the deep coarse sand area having low production, sand over deeper gravelly clay being of medium production and the sand over shallow loamy clay a high production.

The paddock was sown to wheat in May 2017 and barley in May 2018 with the grower's machinery as part of the normal seeding operations. Harvesting of the paddock was carried out by the grower as part of their normal harvest operations. The yield data was extracted from the monitor using Agleader SMS software and statistical analysis carried out using Past3 software (Hammer et al, 2001).

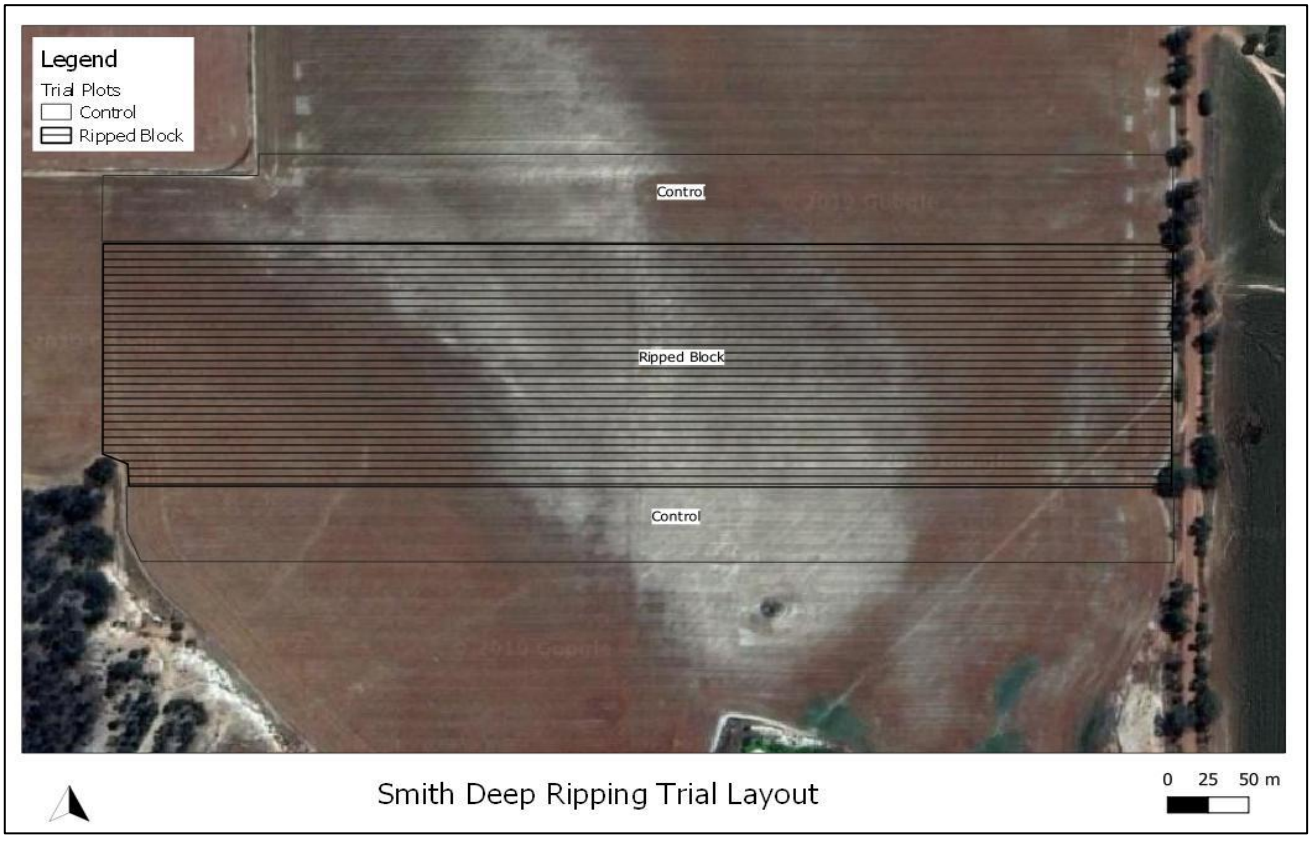

Figure 1: An 11ha area was ripped in block across a deep sand and sand over loamy clay soil types.

For both seasons, 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).

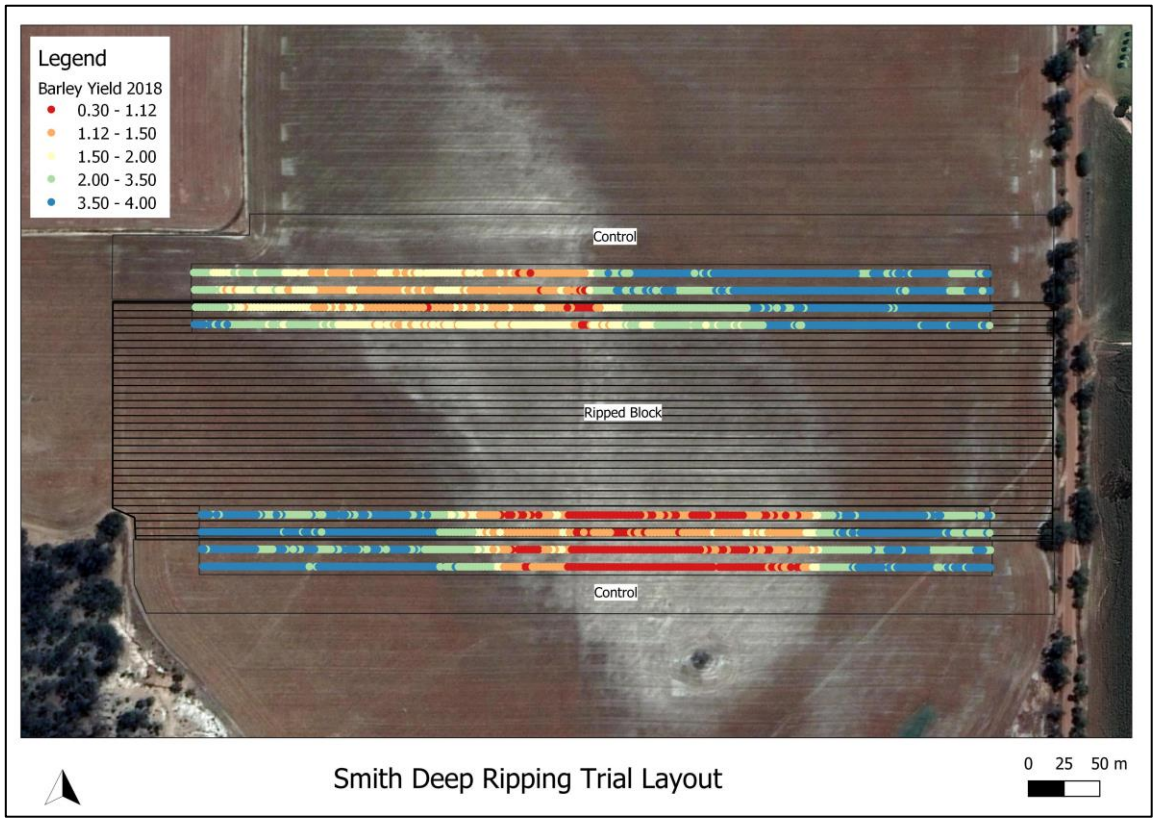

Figure 2: The two closest header passes to the treatment edge were used to compare yield differences between the ripped and un-ripped area.

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).

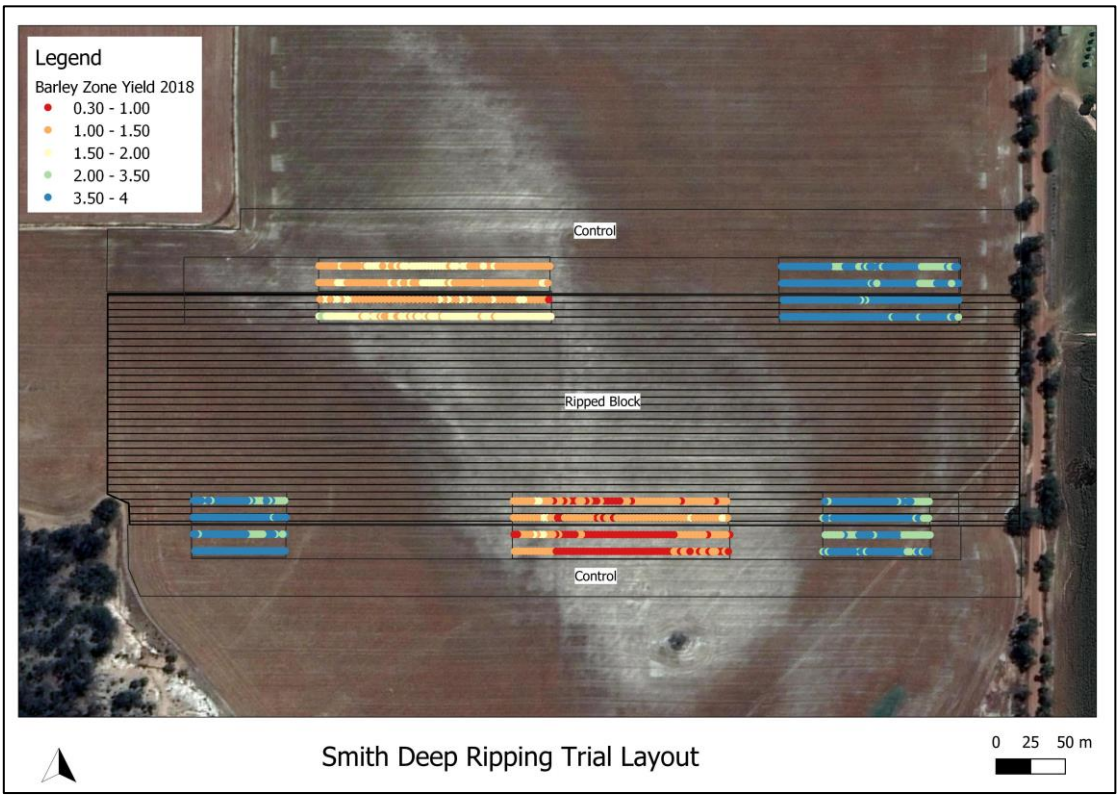

Figure 3: Yield data was split into production zones and differences compared.

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

Yield differences in 2017 and 2018 were initially examined along the entire length of the ripped boundary. A negative yield response was observed on the northern boundary and a positive response on the southern boundary in both seasons. In 2017, 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). A very similar pattern was seen in 2018 with a 300kg loss recorded along the northern boundary and a 60kg increase on the southern boundary (Figure 4)

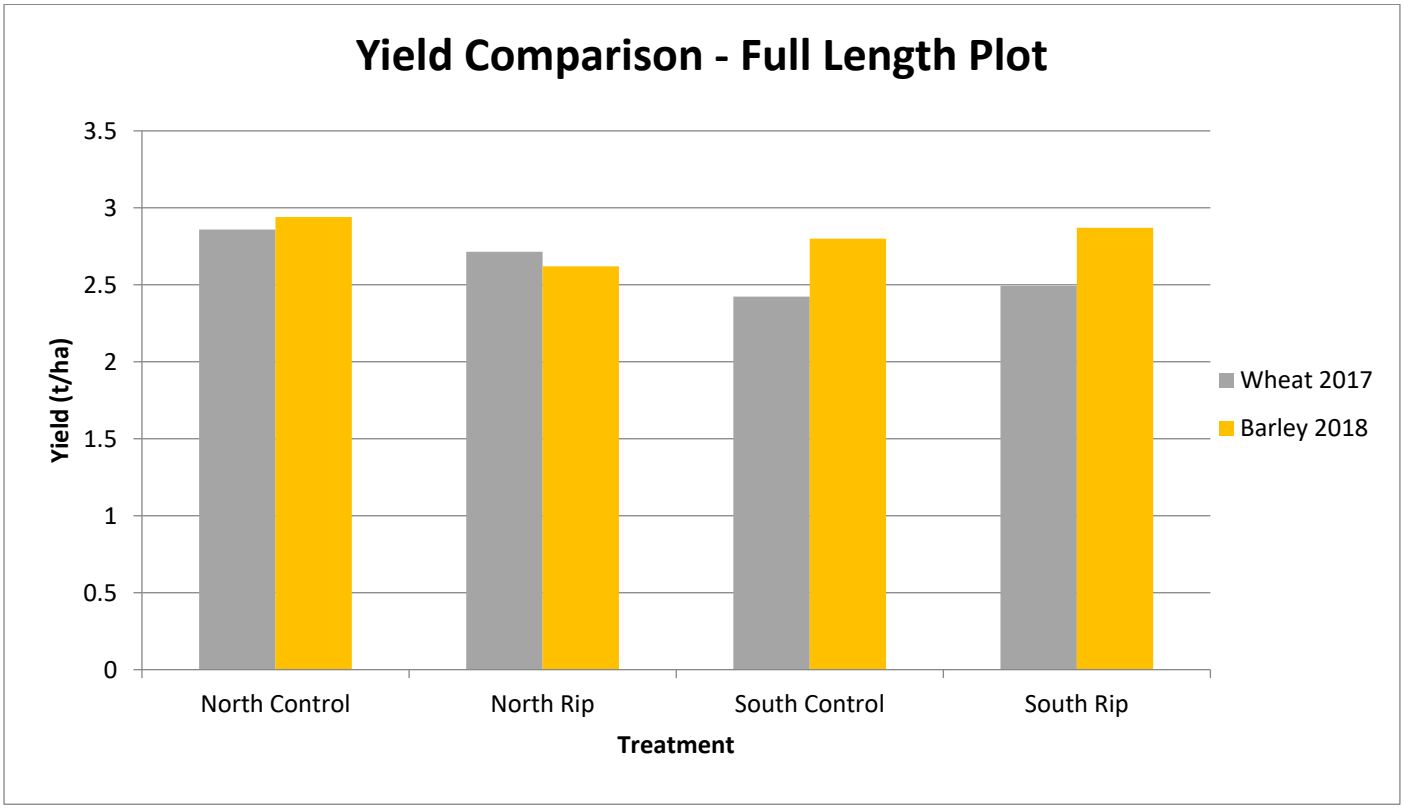

Figure 4: Yield comparison between the ripped and un-ripped area shown mixed results when examining the entire plot length.

Yield differences between production zones along the ripped area boundary were then examined (Figure 5). Zones were correlated to soil type with the deep coarse sand area having low production, sand over deeper gravelly clay being of medium production and the sand over shallow loamy clay a high production

High production zone

Deep ripping increased yield in the high production zones with a 270kg/ha and 400 kg/ha benefit recorded in the ripped plots in 2017 and a 101kg/ha and 443kg/ha yield increase in 2018.

Low and medium production zone

Deep ripping resulted in a 40kg/ha decrease in yield in the medium production zone in 2017 and 38kg/ha yield reduction in 2018.

A 140kg/ha yield decrease in the northern low production zone was recorded in 2017, though a 121 kg/ha increase was recorded in 2018. The low production zone on the southern edge saw a 340kg/ha yield benefit in 2017 and 219 kg/ha increase in 2018 (Figure 5).

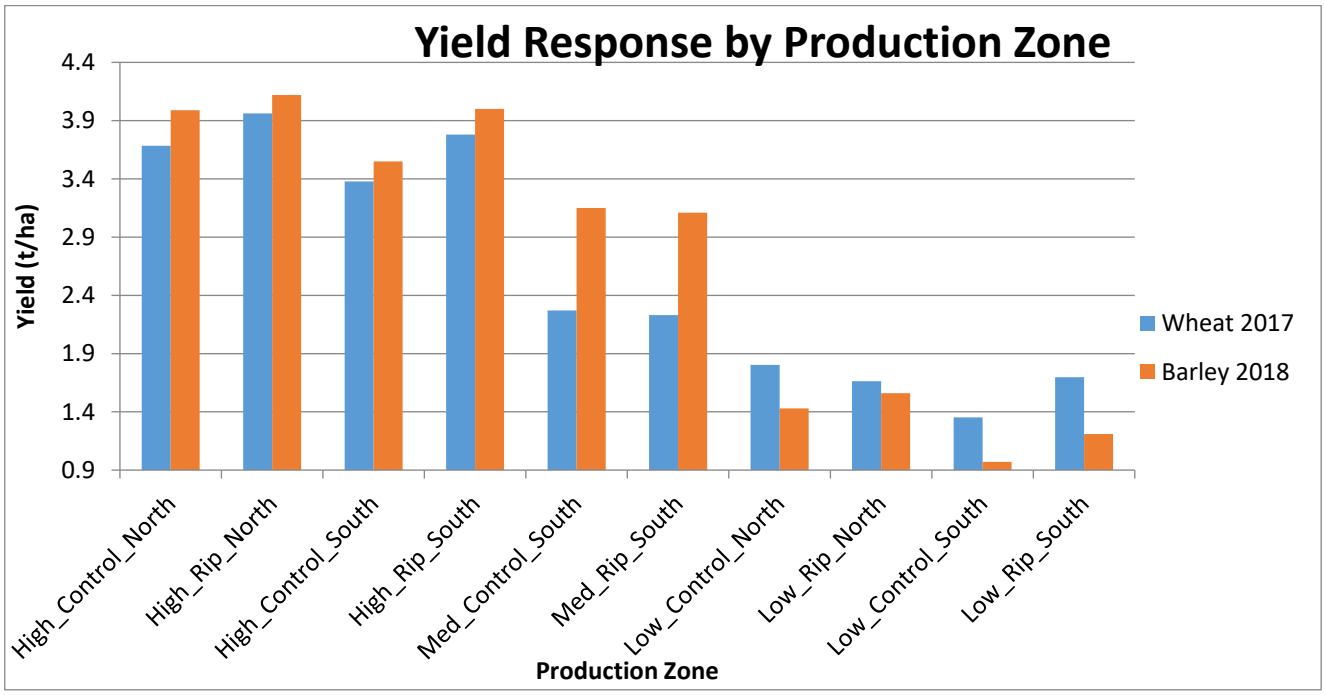

Figure 5: Yield differences in varying production zones where observed at the site.

Soil and Plant Measurements

Soil strength was found to be reduced in the deep ripping treatment when compared to the soil in the adjacent un-ripped area, with a natural reduction in compaction in soil deeper than 400mm where soil strength reduces to just above 2500kpa between 400-600mm in all treatments (Figure 6).

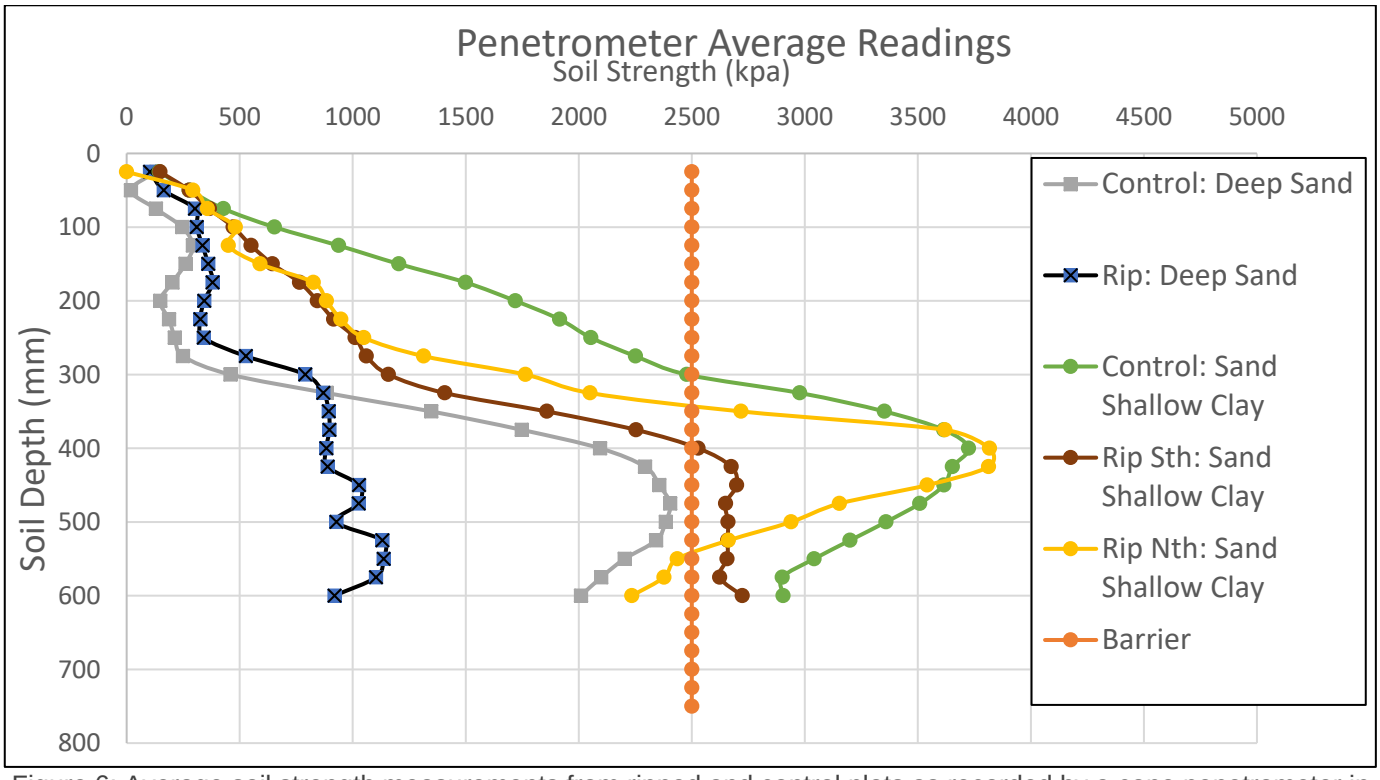

Figure 6: Average soil strength measurements from ripped and control plots as recorded by a cone penetrometer in August 2017.

The control plots reached 2500kpa between 300 – 400mm soil depth and increased to peak at 3500-4000kpa at 400 - 500mm with the exception of the un-ripped deep sand which had the highest reading of just below 2500 kpa.

Deep ripping plots generally maintained compaction levels below 2500kpa to 400mm depth then increased to levels between 2500-300kpa to 600mm. The northern sand over shallow clay plot reached the same soil strength as the adjacent control plot at 400mm soil depth.

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.

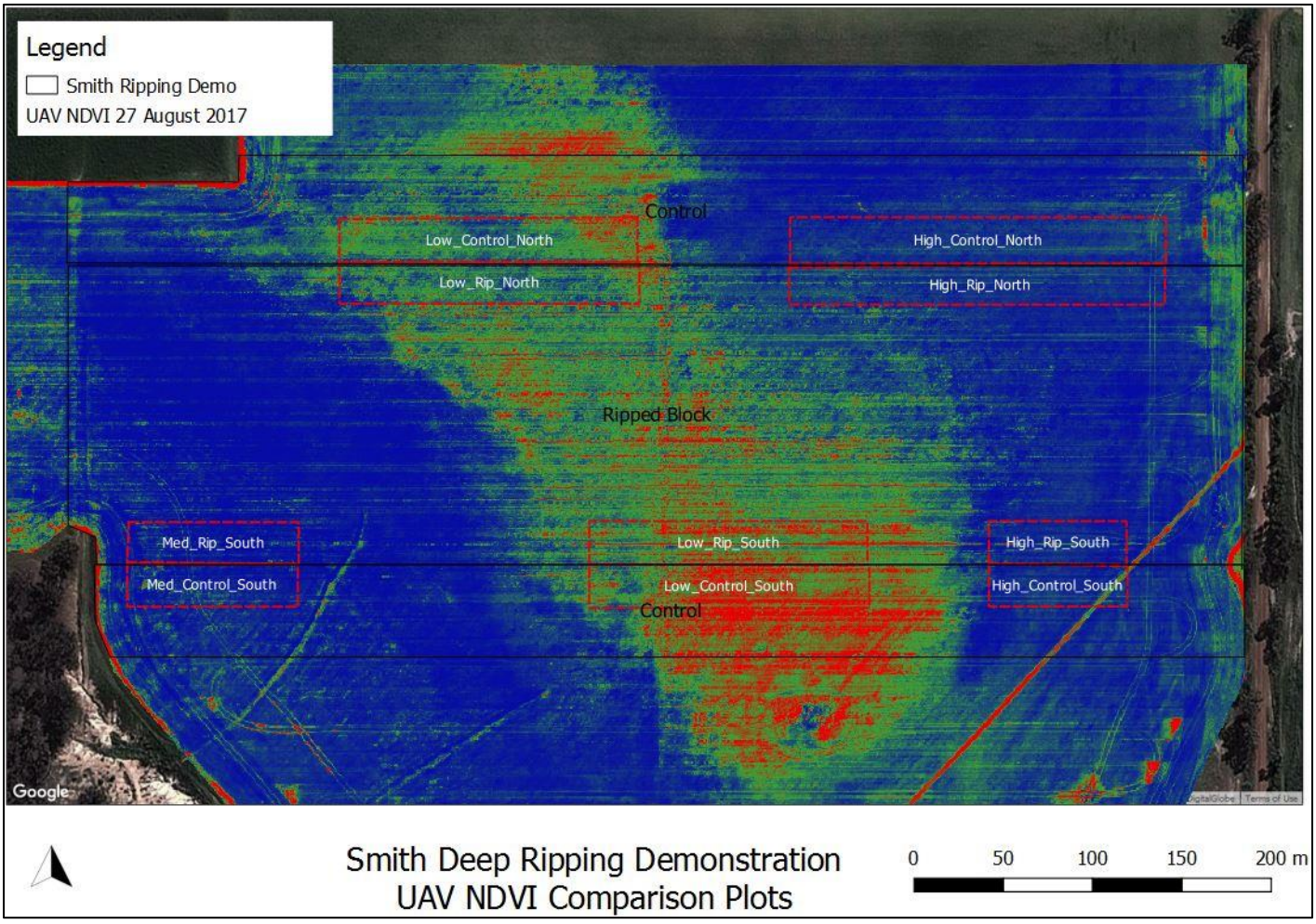

Figure 7: UAV NDVI captured 27 August 2017 shows large variation in crop biomass. Soil type is thought to be the main driver of production at this site

Small visual differences in plant greenness in the boundary of ripped and control areas can be seen throughout each season though it was not consistent along the length of the plots. The imagery captured by the UAV in 2017 shows a large variation in biomass across the site though only small differences in NDVI between the treatment areas (Figure 7).

Returns of Deep Ripping

There was an average net benefit of $51/ha from deep ripping in this paddock over the 2017 and 2018 cropping seasons (Table One).

The sand over shallow clay soil type that was associated with the high production zone, provided the highest returns in both years of the trial with an average benefit of $87/ha. The deeper sands of the medium and northern low productions zones had a negative result with a cumulative loss of $55/ha and $67/ha respectively. The southern low production zone provided positive returns in both years and averaged $82/ha benefit from ripping.

These results are economically significant and make the deep ripping practice worth the effort in the sand over shallow clay and deep sand soil types. The longevity of the treatment effect will determine just how cost effective deep ripping is in this environment and on these soil types.

Table 1: The annual benefit 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 North	-	-	-	-	-
High Rip North	45	22.5	83.3	32.5	70.8
High Control South	-	-	-	-	-
High Rip South	45	22.5	120.5	112.5	188.0
Med Control South	-	-	-	-	-
Med Rip South	45	22.5	-12.0	-10.0	-67.0
Low Control North	-	-	-	-	-
Low Rip North	45	22.5	-42.1	32.5	-54.6
Low Control South	-	-	-	-	-
Low Rip South	45	22.5	103.4	60.0	118.4
Average	-	-	50.6	45.5	51.1

Conclusion

Deep ripping provided mixed results on the various soil types found in this paddock and suggest that deep ripping will be profitable only on the sand over shallow clay and deep sand soil types. The significant yield increases in these zones were profitable though the benefit was negated by the loss incurred in the soil types of the medium and low productions zones. This indicates that deep ripping should be restricted to the higher production zones that have sand over shallow clay or the low production zones that have deep sand, avoiding the deep sand over gravelly clay that make up the medium production zones.

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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