Assessing the impact of deep ripping and spading across three soil types near Quairading, Western Australia.

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Key messages

1. Deep ripping and spading increased yield between 68% and 107% at this site.
2. Combining deep ripping and spading can ameliorate multiple soil constraints.
3. Leaving untreated control strips can be used to quantify the yield differences of the treatment.

Aims

To assess the impact of deep ripping and spading on crop yield across three different soil types near Quairading, WA.

Method

A 100ha paddock north east of Quairading WA was deep ripped using a 4 metre Heliripper with a maximum working depth of 700mm and spaded with a 4 metre Farmax Spader working between 250-300mm in February 2017.

The ripped and spaded area covers three distinct soil types consisting of deep white sand, deep yellow sand and sand over gravel duplex. Two 45 metre wide by 1000 metre long control strips were left untreated and allowed for the effect of treatment on yield and soil conditions to be made (Figure 1).

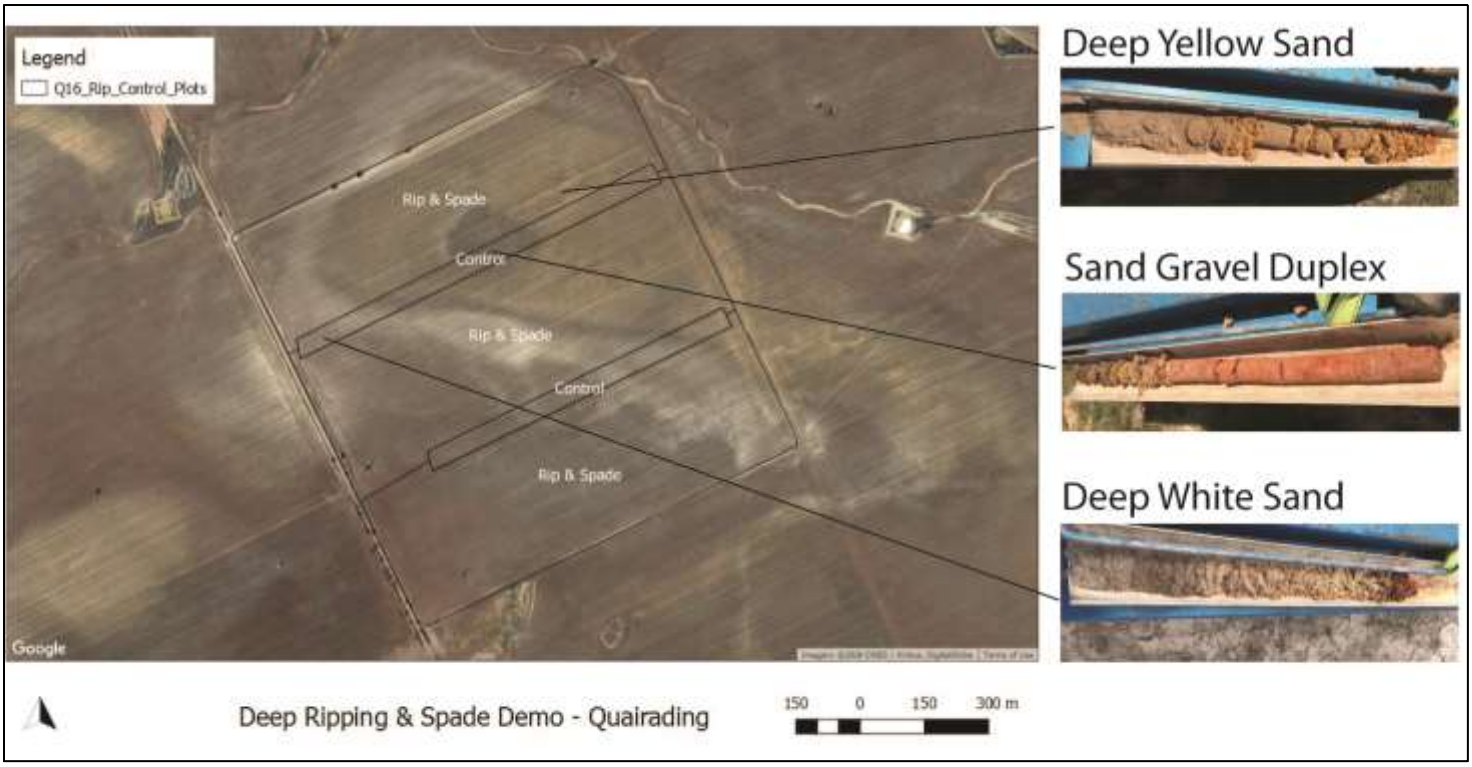

Figure 1: Deep ripping and spading was carried out in a 100ha paddock near Quairading WA. Two control strips allowed for the effect of the treatment to be measured. Soil types were assessed via coring prior to rip and spading.

The paddock was sown to wheat with the grower's machinery in May 2017 as part of the normal seeding operations. Harvest strips (100m long by 12.2m wide) along the boundary between the treated and control areas were used to collect yield data for each soil type using the farmers harvester and yield being recorded using a weigh trailer (Figure 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 was measured at 48 locations along each rip and control plot using a Rimick CP300 digital cone penetrometer to assess differences in soil compaction. This was made up of five insertions at 12 locations along the northern edge of each control strip. Insertions locations were randomly chosen outside the ripped and spaded area though the ripping line was found and measurements taken from within the rip line for the ripped section. Measurements in the sand over gravel duplex soil type were not included in this analysis as the gravel in the soil made the data invalid.

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.

Soil wetting repellence was assessed via the soil molarity ethanol droplet (MED) test.

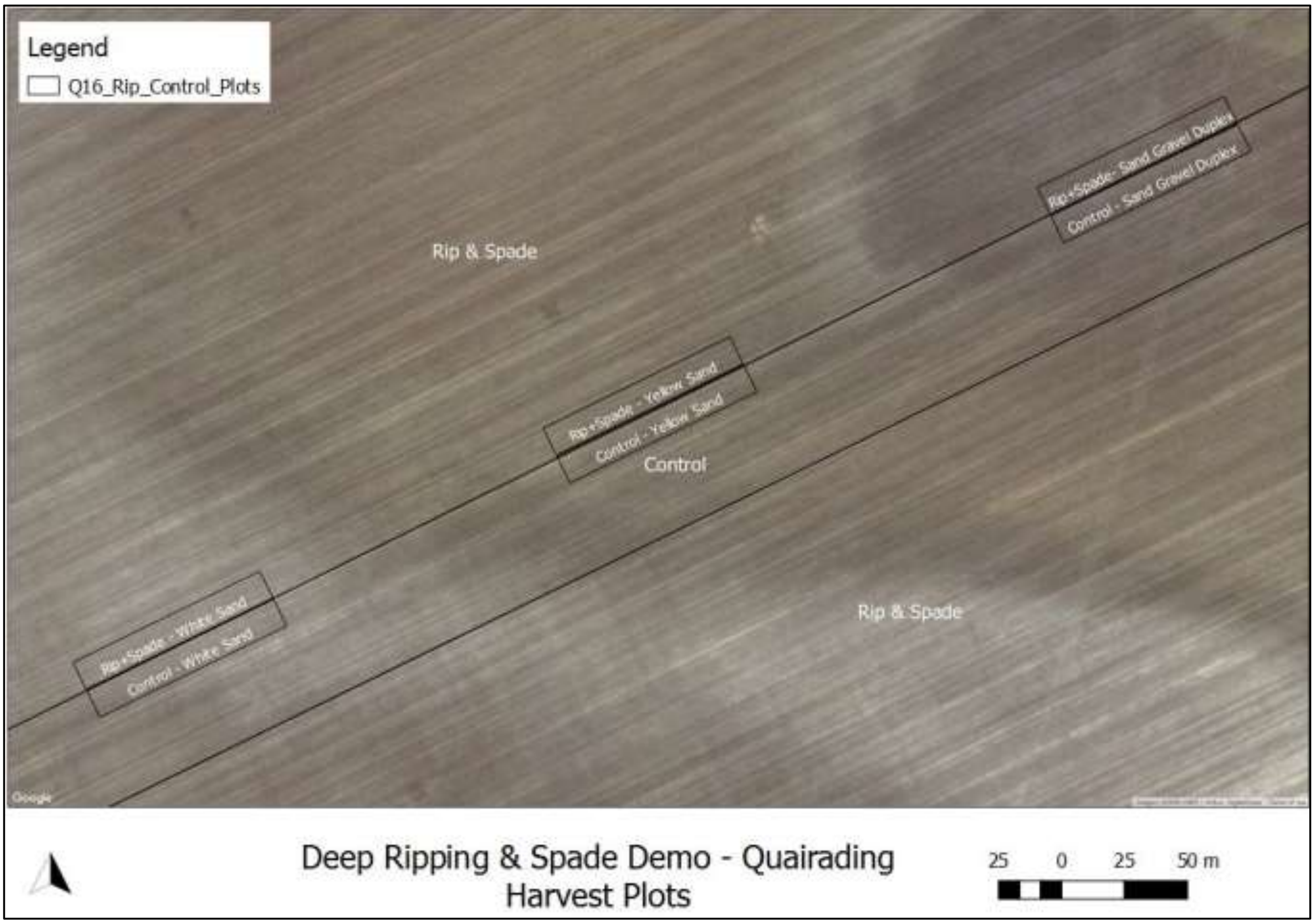

Figure 2: Yield data was collected along the boundary of the ripped + spaded and control areas in three soil types.

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, though the size of the yield differences provides confidence that the effects are likely to be seen in other areas that have similar soil constraints.

Large yield differences between ripped and spaded and control areas were seen across all soil types (Figure 3). The largest difference was recorded in the deep yellow sand where yield increased by 1,148kg/ha, an almost 108% benefit to deep ripping and spading. A similar yield increase of 1,107kg/ha, a 68% benefit, was recorded in the sand over gravel duplex soil type and in deep white sand were 451kg/ha, or 68% increase was observed.

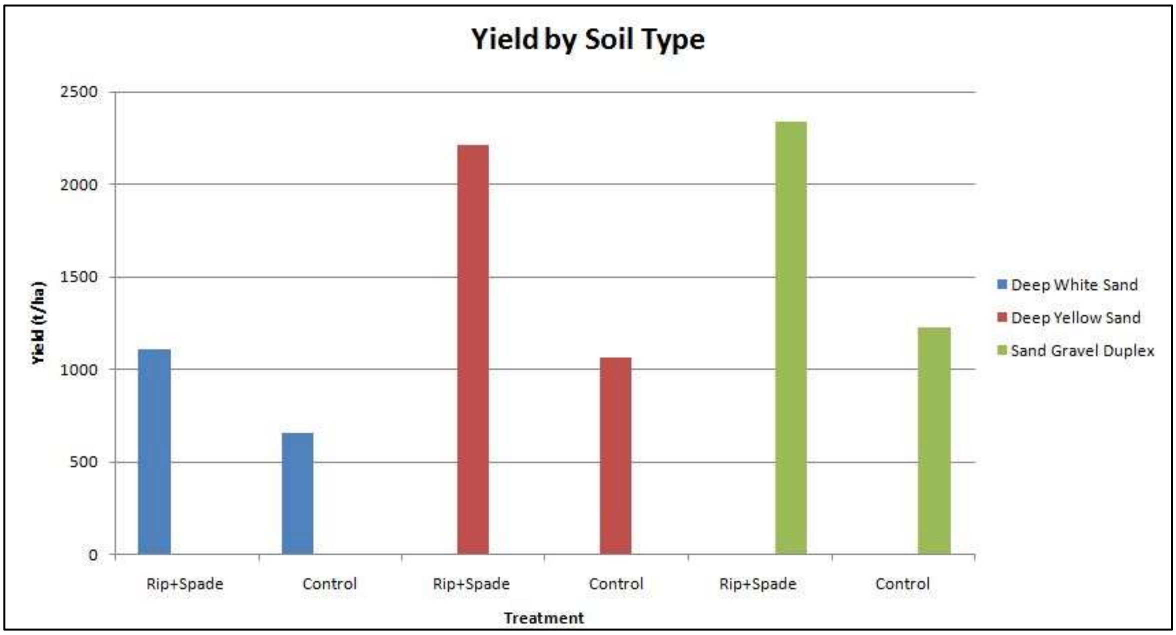

Figure 3: Large yield differences due to deep ripping were recorded across all soil types.

Soil and Plant Measurements

The average soil strength was found to be reduced in the deep ripping and spaded area when compared to the adjacent un-ripped soil (Figure 4). The control strips consistently reached 2500kpa between 200 – 250mm soil depth and increased to peak at over 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 2000kpa at 750mm.

Deep ripping plots generally maintained compaction levels below 2500kpa to 750mm 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 fully remove compaction as a constraint in the sandy soil types.

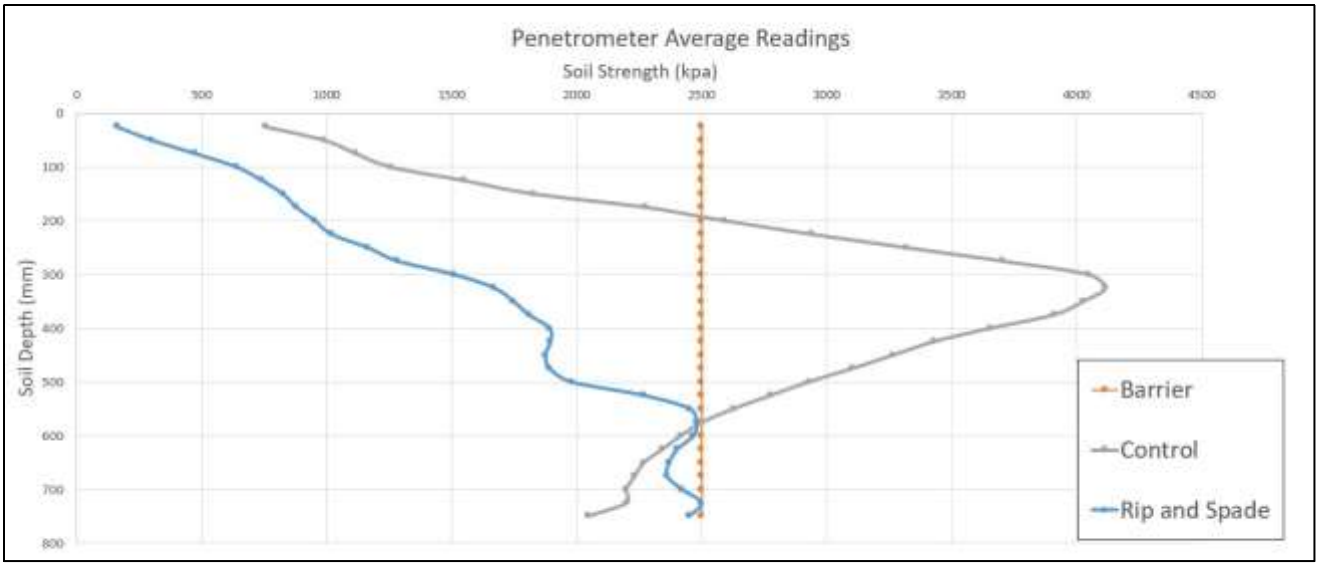

Figure 4: Average soil strength measurements from ripped and control plots as recorded by a cone penetrometer in August 2017.

A large difference in plant biomass was observed between ripped and spaded and control areas when the site was visited throughout the season. This is highlighted in the NDVI imagery captured by the UAV that shows a much more even plant density and biomass exists in the treated areas (Figure 5).

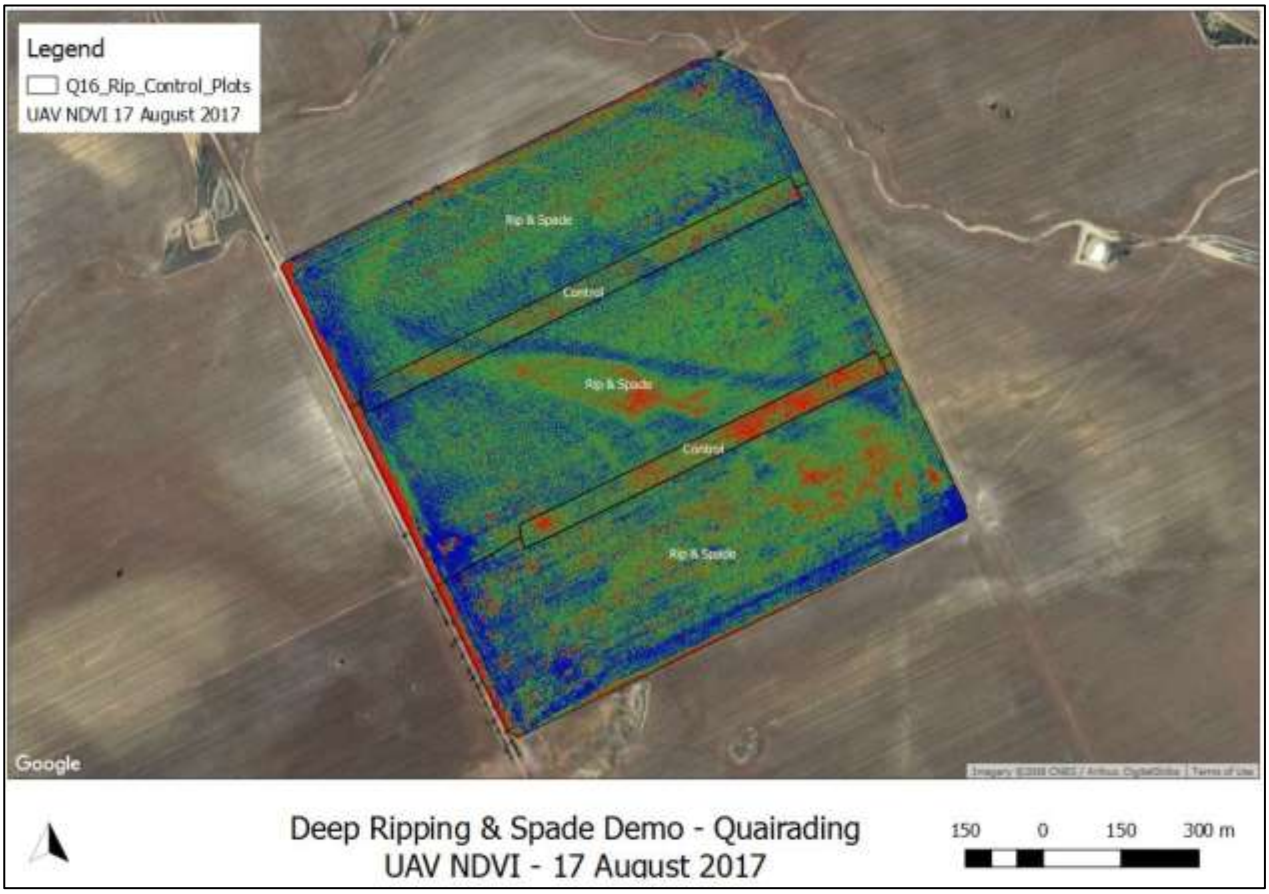

Figure 5: A large difference in plant biomass was observed between ripped and spaded and control areas when visiting the paddock throughout the season. This is highlighted in the NDVI imagery captured by the UAV that shows a much more even plant density and biomass exists in the treated areas.

The UAV NDVI also captured localised areas within the control strips that showed very poor growth that was thought to be due to severe, localised non wetting not picked up in the MED test or soil disease. This effect was not seen in the treated areas and indicates that yield increases seen in this site may be due to more than just the removal of compaction as a soil constraint. More investigation into the cause of these areas will be carried out during the 2018 season.

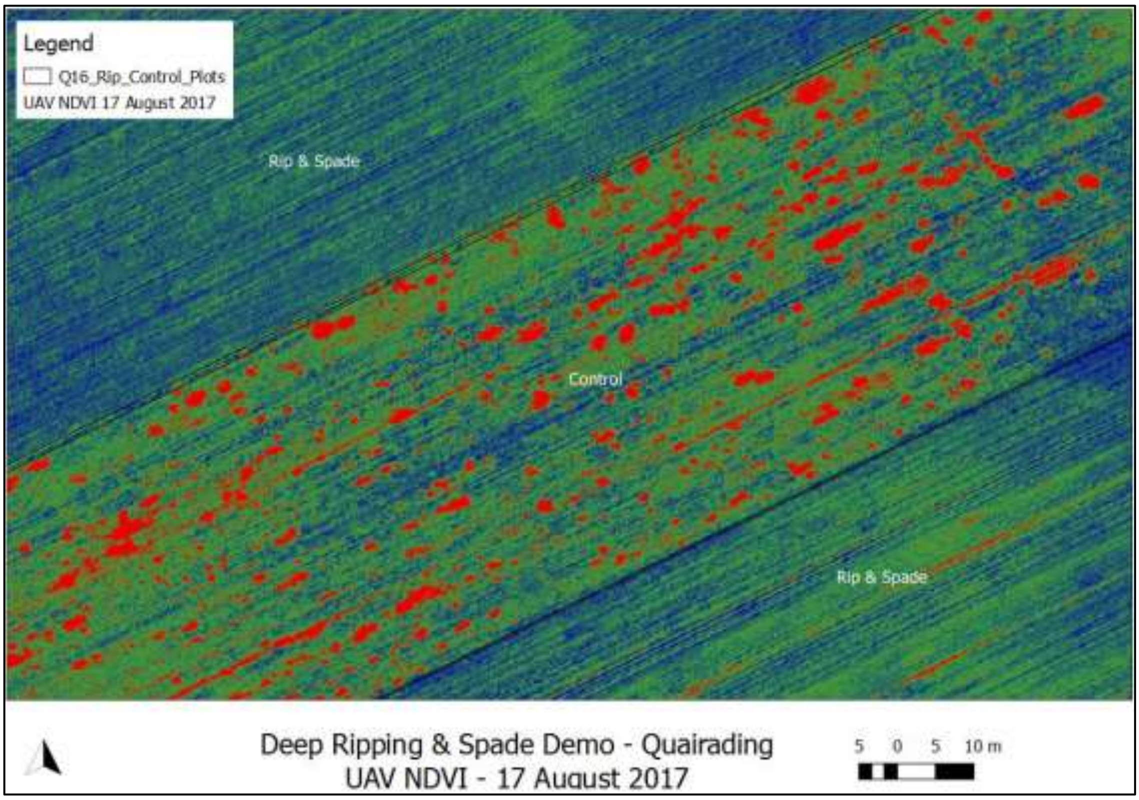

Figure 6: Paddock scale UAV NDVI captured 27 August 2017 shows large variation in crop biomass.

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 demonstration encourage further replicated trials to accurately quantify the benefits of deep ripping in the area. Due to the very large yield increase seen in the treated areas it is thought that there has been a positive return on investment though actual costs of the treatment and prices of crops would need to be examined.

The yield responses to deep ripping and spading 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 and spading 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 very large positive yield responses to the deep ripping and spading in 2017. Increased yield 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 and spading effect and therefore how likely it is an ongoing economic advantage will be realized from the practice.

Acknowledgments

The research undertaken as part of this project is made possible by the significant contributions of the grower and Tim Boyes who setup the demonstration sites. This assessment of the trial and report is funded by the GRDC through the Albany Region Cropping Solution Network.

GRDC Project Number: AVP00003-A