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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Demonstration of value of inclusion plates on slotting lime into the subsoil over deep ripping alone on two north Hyden sandy loams: 1st year results (2017), Kwinana East

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Key messages

- Compaction is a subsoil constraint in North Hyden sandy soils.
- The first year of results indicate that deep ripping can be profitable in these soil types in North Hyden.
- The site variation and the design of the demonstration highlighted the response is not guaranteed; more investigation is required to identify why certain parts of the demonstration were more responsive than others to deep ripping and how to map and identify soils responsive to deep ripping.

Long-term aims of the demonstrations

- To evaluate the benefit of deep ripping on two different compacted sandy loams with varying subsoil acidity
- To evaluate the value of inclusion plates in slotting lime to the subsoil
- Evaluate the longevity of the response and returns over multiple seasons and crop rotations

Background

Subsurface acidity and compaction are two subsoil constraints prevalent in the WA wheatbelt, often occurring together. Different management strategies are required to ameliorate each constraint separately, but the most economical approach to ameliorate both together is not well defined across the various regions and soil types in WA.

Recent DPIRD deep-ripping research has been conducted investigating the value of ‘deeper’ deep ripping and slotting topsoil down the seam made by the ripping tynes on various soil types and zones in the WA wheatbelt. These two demonstrations were instigated to demonstrate the value in an area where trials have not currently been conducted, as well as provide an indication of slotting lime and topsoil in the same pass as deep ripping, longevity and respective returns on investment.

The host farm has a good liming history, however no mechanical incorporation of lime or tillage to remove compaction or incorporate lime has been done on this property since the implementation of minimum-till. The implementation of the inclusion plates slotting topsoil and lime to depth may be an appropriate method over more rigorous strategic

tillage methods for the growers in this region as soil types are highly variable which makes some tillage options challenging and a greater risk for wind erosion.

Site details

	Woolocutty	North Hyden
Soil type	Sandy loam	Sandy loam
pH ($CaCl_2$)	0-10cm: 5.53 30-40cm: 4.58 10-20cm: 4.23 40-60cm: 5.17 20-30cm: 4.35 60-80cm: 4.13	0-10cm: 5.30 30-40cm: 4.53 10-20cm: 4.45 40-60cm: 4.25 20-30cm: 4.38 60-80cm: 4.13
Crop history	2016: Wheat	2016: Canola
2017 Crop	50 kg/ha Yitpi wheat sown 8th May	55 kg/ha Mace wheat sown 8th May
Rainfall	Mt Walker: 147mm Jan-Apr; 159mm May-Oct	Hyden: 202mm Jan-Apr; 230mm May-Oct

Methods

Two deep ripping by lime large-scale demonstrations were established in two paddocks in north Hyden in March, 2017 in a strip-plot design. The paddocks have had approximately 3 t/ha lime spread over it historically. For the demonstration, single strips of an additional rate was spread by the farmer for the length of the paddock at 1.5 t/ha, 3 t/ha and 4.5 t/ha, as well as a 7.6 t/ha strip of farm sourced gypsum (30% purity) at one site (Woolocutty). The deep ripping treatments were implemented after the lime was spread in 100m blocks for the entire width of the lime treatments (12m). Between each ripped block was 100m left unripped. Deep ripping was done in the same direction as runlines with DPIRD's modified grizzly to 500mm without the inclusion plates and 450mm with the inclusion plates, with a 50cm tyne spacing.

No recent mechanical incorporation had been done on this property prior to the demonstrations.

Sub-sampling transects were established within the 100m plots at 30m, 50m and 70m. Plants/m^2, heads/m^2, grain yield, grain protein and screenings were conducted at each sub-sampling point.

Results

Both sites had severe subsurface compaction beginning at approximately 15cm. Deep ripping was sufficient to remove the hardpan at both sites (Fig. 1). The addition of inclusion plates increased engine load by 10% at both sites and fuel use by 8% and 11% at Woolocutty and North Hyden respectfully.

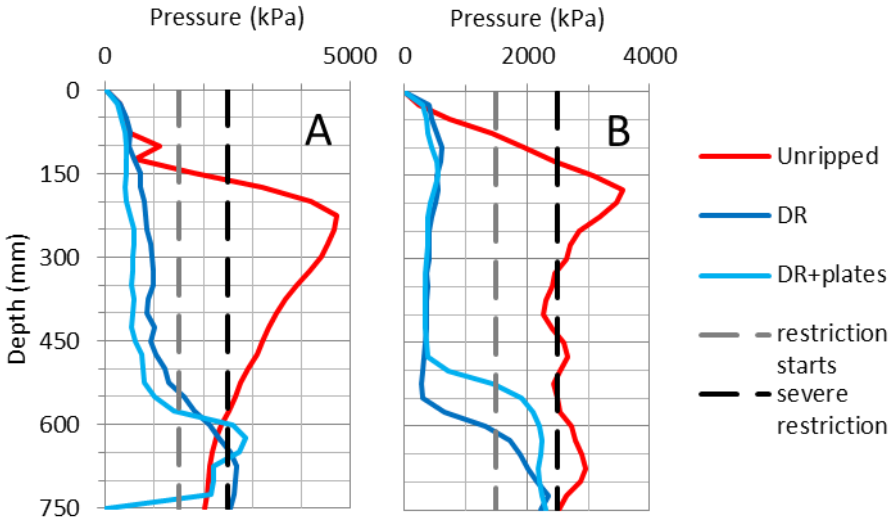

Figure 1: Soil strength profile at two deep ripping demonstrations sites a) Woolocutty b) North Hyden

Although crop establishment appeared poorer within the deep ripping treatments at both sites due to poor seed placement/deep burial (in particular the in the ripped plots with inclusion plates), the plants per m^2 were the same in all ripping treatments. The deep ripped plots with inclusion plates had more heads per m^2 than the unripped plots at Woolocutty, however there were no differences between head counts in ripping treatments at North Hyden (Table 1).

Table 1: Average plant establishment and wheat head counts in deep ripping demonstrations, Hyden. Letters after values indicate significant different/similar means.

Treatment	Woolocutty		North Hyden	
	Plants/m^2	Heads/m^2	Plants/m^2	Heads/m^2
Not ripped	101	151 *b*	87	136
Deep ripped	102	187 *ab*	81	146
Deep ripped with inclusion plates	89	211 *a*	72	144
Ripping	*ns*	*P = 0.019*	*ns*	*ns*
Lime	*ns*	*ns*	*P = 0.067*	*P = 0.016*
Ripping x lime	*ns*	*ns*	*0.05*	*P = 0.002*

There was no yield response to lime or gypsum at the Woolocutty site, however both deep ripping treatments yielded more than the unripped plots (Figure 2a). Grain quality did not change with deep ripping (Table 2), however the 1.5 t/ha lime had 2 g difference in its 1000 grain weight relative to the other lime and gypsum treatments (data not shown).

There was a positive trend to deep ripping, but the response was not statistically different to the unripped plots at the North Hyden site as whole (Figure 2b). Viewing the deep ripped blocks independently however, the southern part of this paddock appears non-responsive to deep ripping, whereas the northern section was so (Figure 3b). There was a significant yield response to lime and an interaction with lime and ripping at this site,

however without further investigation into the site and its variability, these results are viewed with caution (Table 2, Figure 2b).

There was no yield difference between deep ripping with and without inclusion plates at either site.

Table 2: Average grain yield and quality determined by hand cuts in deep ripping demonstrations, Hyden. Letters after values indicate significant different/similar means.

Treatment	Woolocutty				North Hyden			
	t/ha	Protein (%)	Screenings (%)	1000 grain weight (g)	t/ha	Protein (%)	Screenings (%)	1000 grain weight (g)
Not ripped	1.73 *b*	9.04	1.4	37.48	2.48	9.26	0.2	45.05 *a*
Deep ripped	2.33 *a*	9.00	1.6	36.69	3.25	9.22	0.1	44.96 *a*
Deep ripped with inclusion plates	2.79 *a*	9.19	1.3	37.46	3.05	8.88	0.3	43.65 *b*
Ripping	*0.008*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*0.028*
Lime	*ns*	*ns*	*ns*	*0.019*	*0.009*	*0.042*	*ns*	*ns*
Ripping x lime	*ns*	*ns*	*ns*	*ns*	*0.004*	*0.008*	*ns*	*ns*

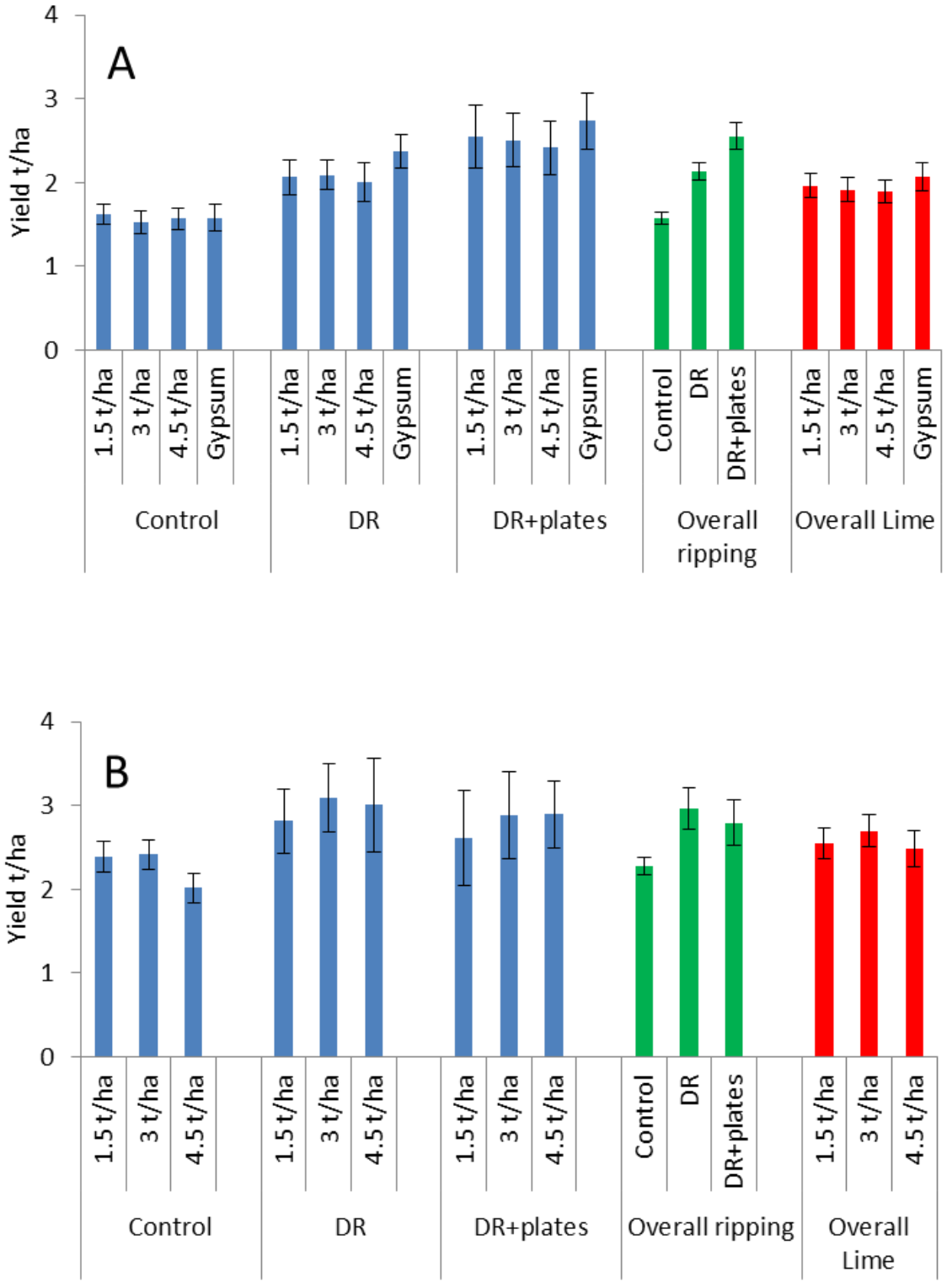

Figure 2: Yield from handcuts for each of the treatments and interaction between ripping at lime in two paddocks a) Woolocutty b) North Hyden. Error bars indicate 95% CI

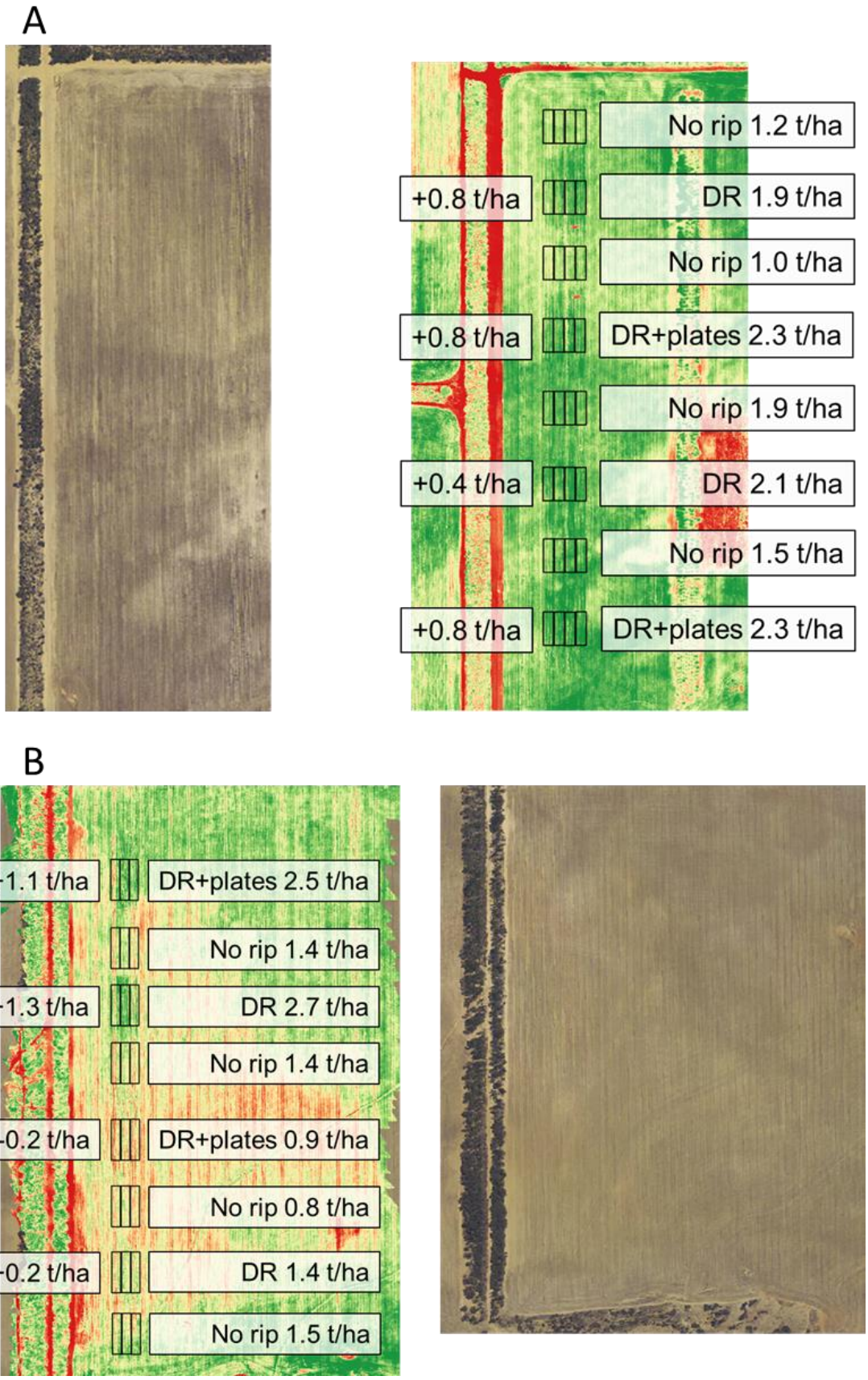

Figure 3: In-season NDVI and yield from header yield map displaying the variation in the response to deep ripping in two paddocks a) Woolocutty b) North Hyden

Return on ripping

The estimated costs of deep ripping at these sites averaged to $48/ha and $52/ha without and with inclusion plates respectfully. These are based on the assumptions at the time of ripping (fuel use and ground speed), $0.871/L fuel price and $20/a wear and tear without the plates and $21/ha with the inclusion plates. These estimations do not include labour, depreciation of machinery or other overheads.

Assuming a farm-gate price of $250/t, an approximate 0.6 t/ha yield improvement is required for a 200% return on investment (ROI) on deep ripping. This was achieved at the Woolocutty site, but not consistently at the North Hyden site. The lime treatments will impact the ROI on each treatment, which will be evaluated over time.

Conclusion

Compaction is a subsoil constraint in North Hyden sandy soils. The first year of results indicate that deep ripping can be profitable in these soil types in North Hyden.

The site variation and the design of the demonstration highlighted the response is not guaranteed (Figure 3); more investigation is required to identify why certain parts of the demonstration were more responsive than others to deep ripping.

Further soil testing to evaluate the effectiveness of deep ripping with and without inclusion plates for lime movement down the soil profile will be valuable at these sites.

Continual monitoring of these sites over multiple seasons and crops will aid understanding the value of deep ripping in the Hyden area on these soil types.

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Important disclaimer