Deeper deep ripping and water use efficiency

GRDC RCSN Geraldton GER9

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Key Messages:

- Ripping below the hard pan in sandy soils and yellow loams in wheat or canola increases yield.
- Ripping deeper allows more plant roots to access moisture deeper in the profile for longer in the season.
- Leaving a firm even seed bed after deeper ripping is important to reduce seeding establishment issues.
- Crop yield response to ripping does vary depending on seasonal conditions and crop type therefore the economics of ripping must be considered over multiple seasons.

Why do the Trial?

Subsoil compaction caused by heavy machinery has a negative impact on grain yield across the Geraldton Port Zone (as well as all others in WA). Compaction limits plant root growth effectively reducing plant available water capacity (PAWC) which in turn limits yield potential.

Trials in 2015 by Department of Agriculture and Food WA GRDC funded project DAW00243 showed deeper deep ripping (55cm) could increase yield by more than 0.8 t/ha on a sandplain soil. This is deeper than current standard practice of ripping to 35cm. As a result farmer interest in deep ripping and 'deeper' deep ripping is on the rise. However many questions remain. How deep do I need to rip? Is there a different requirement across soil types? How long will my ripping benefit last? What about in the low rainfall zone where yields are lower – will it pay?

Farmers and advisers also want to know how PAWC changes as a result of ripping / deepening the depth of soil that plant roots can access. Understanding PAWC allows those using Yield Prophet (and other tools) to better assess likely crop yield as the season unfolds and thus make better crop input decisions.

This aim of this project is to gain a better understanding of the benefits of deep ripping and in particular depth of deep ripping required to optimise crop yield & profit for different soil types and rainfall zones in the Geraldton port zone.

Trial details

Table 1. Deeper ripping demonstration site details in the Geraldton Port Zone

Site	1	2	3	4	5
Grower	Cripps	Paul Messina	Spring Park farms	Matt Freeman	Bagley
Location	Oglivie	Eradu	Mullewa	Walkaway	Arrino
Soil type	Yellow sand	Yellow sandplain	Red loam	Pale sand	Yellow loam
Variety	Lupins Gunyidi 100kg/ha	Mace wheat 60kg/ha	Mace wheat60kg/ha	Mace wheat	Canola
Sowing date	23 May	4 May	4 May	5 June	15 April
GSR mm	319	280	242	330	291
Rotation 2015	Wheat	Wheat	Wheat	Lupin	Wheat
Ripper	Ausplow	Bednar Terralanda	Ausplow and Helipripper	Nufab Tilco	Paxton

Table 2. Treatments

Site	Treatments
1	Unripped, ripped 300mm,ripped 420mm with topsoil inclusion plates
2	Ripped 350mm, ripped 600mm, ripped 600mm+wings
3	Unripped, ripped 300mm, ripped 550mm
4	Unripped, ripped 300mm,ripped 600, ripped 600+ inclusion plates
5	Unripped, ripped 300mm, ripped 500mm

All farms are in Controlled traffic. Plots are at least one width of the header and run the length of the paddock. Trials were harvested and yield recorded using the yield mapping software.

The paddocks were ripped using the on farm ripper. The deeper ripping treatment depth varies due to the soil conditions and depth the ripper was able to be pulled. Despite only achieving a ripping depth of 420mm at Ogilivie this was deep enough to break through the compaction layer. Penetrometer measurements indicated a hard pan was removed in sandy soils although below the ripping depth on the red loam and pale sand was still a hard layer. ’

Soil moisture probes have been installed in the three main treatments at each site to measure soil water to 80cm. Soil testing at 10cm increments including Particle Size Analysis information was utilized to determine estimated Crop Lower Limit (CLL) and Crop Drained Upper Limit (DUL). Soil moisture levels have been monitored through the growing season to assist with identifying differences in soil water usage between treatments. No significant issues with sub soil acidity were identified at any site. Soil penetrometer readings however did identify soil compaction as a sub soil constraint at all sites.

Results

Table 3. 2016 Average yield (t/ha) deeper ripping demonstration sites in the Geraldton port zone

Site	Unripped	Shallow	Deep	Deep+wings or plates
Yellow sand lupins Ogilvie	3.53	3.05	2.61	
Yellow loam canola Arrino	3.05	3.24	3.70	
Pale sand wheat Walkaway	1.69	2.27	2.59	2.80
Red loam wheat Mullewa	3.30	3.62	3.43	
Yellow sandplain wheat Eradu		2.24	2.57	2.72

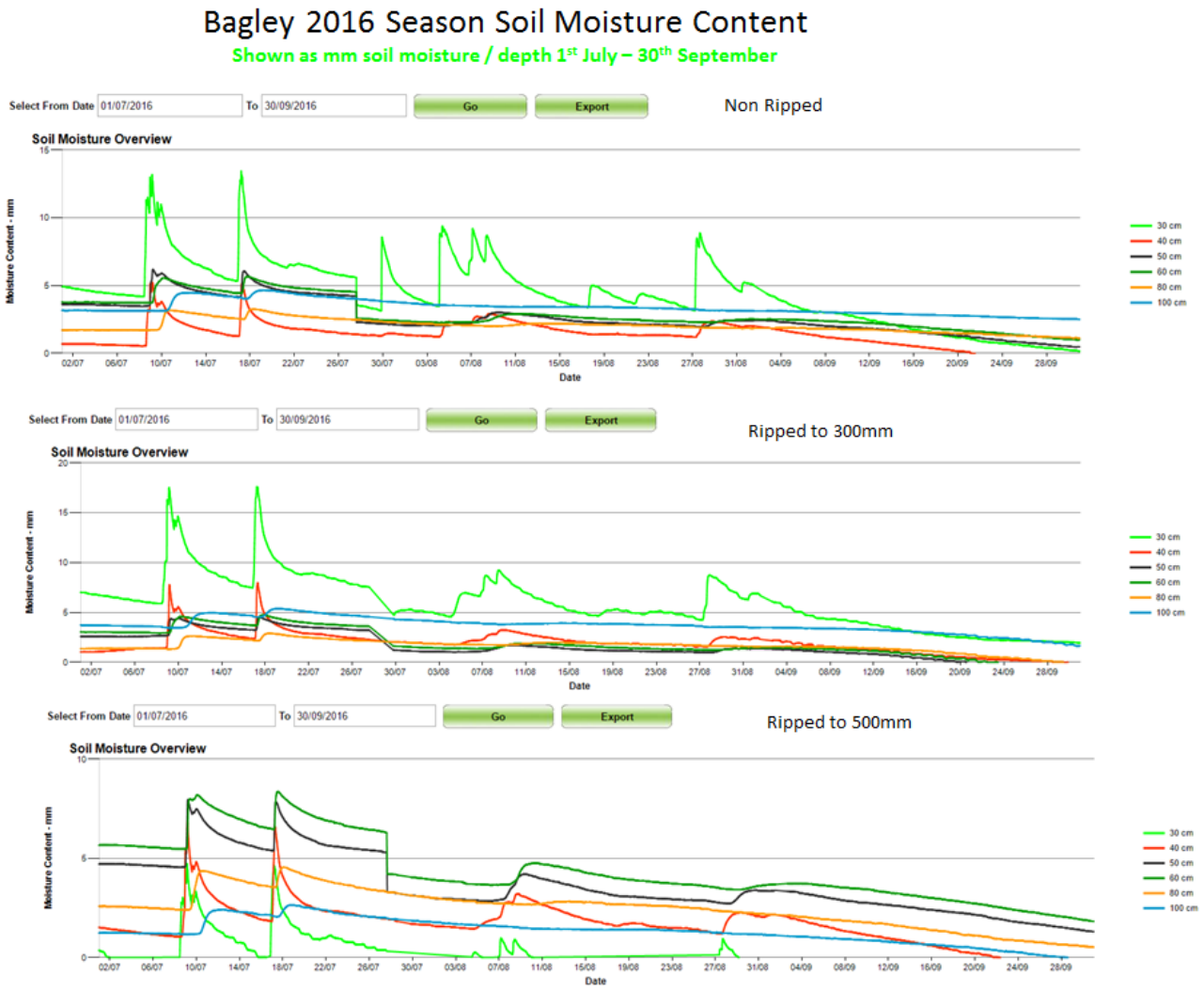
Shallow=Ripped 300-250mm deep = ripped 420-600mm Eradu site deep+wings wide points and low wings, Walkaway Deep+topsoil inclusion plates

Table 4. 2016 Gross margin deeper ripping demonstration sites in the Geraldton port zone (Grain price lupins $280/t canola $550/t wheat $270/t cost ripping shallow $45/ha and deep $75/ha)

Site	Unripped	Shallow	Deep	Deep+wings or plates
Yellow sand lupins Ogilvie	$0	-$224	-$408	
Yellow loam canola Arrino	$0	$58	$276	
Pale sand wheat Walkaway	$0	$111	$168	$225
Red loam wheat Mullewa	$0	$43	-$38	
Yellow sandplain wheat Eradu	$0	$46	$54	

Shallow=Ripped 300-250mm deep = ripped 420-600mm Eradu site deep+wings wide points and low wings, Walkaway Deep+topsoil inclusion plates

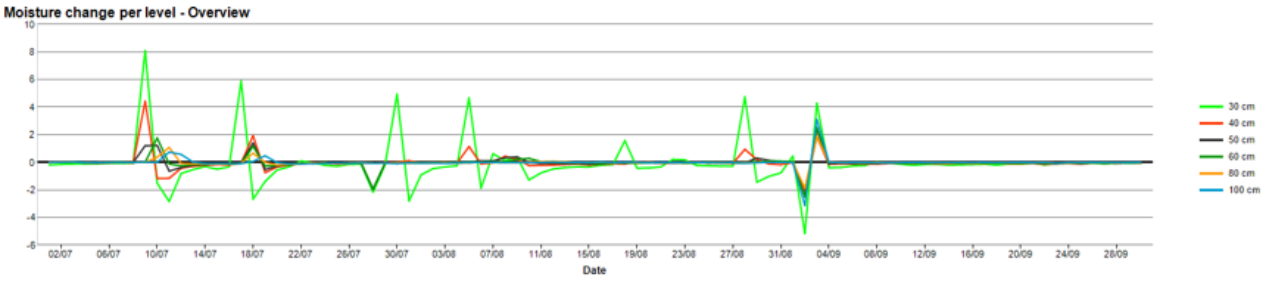
Seasonal soil moisture change is shown below for the 3 probes installed at the Bagley canola site Arrino for the period 1st July through until 30th September 2016.

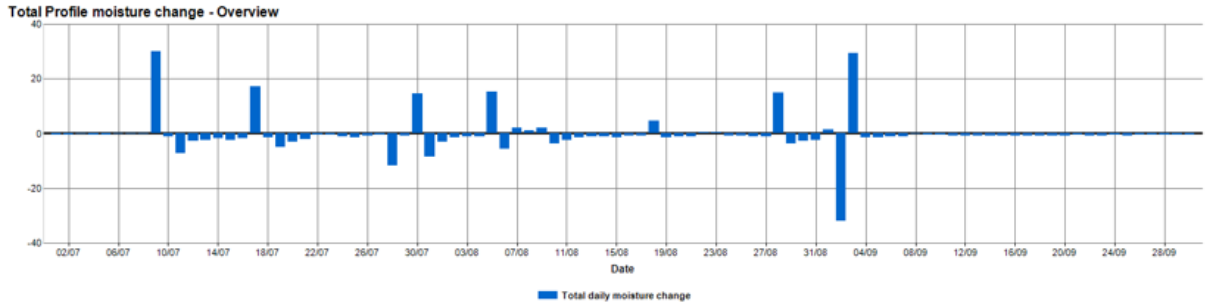


The following graphs show the daily soil moisture usage through the period 1st July to the 30th September at the Bagley site. Data is shown in mm of soil moisture utilized per day.

Bagley – Non Ripped – Daily Soil Moisture Usage 1st July – 30th August 2016

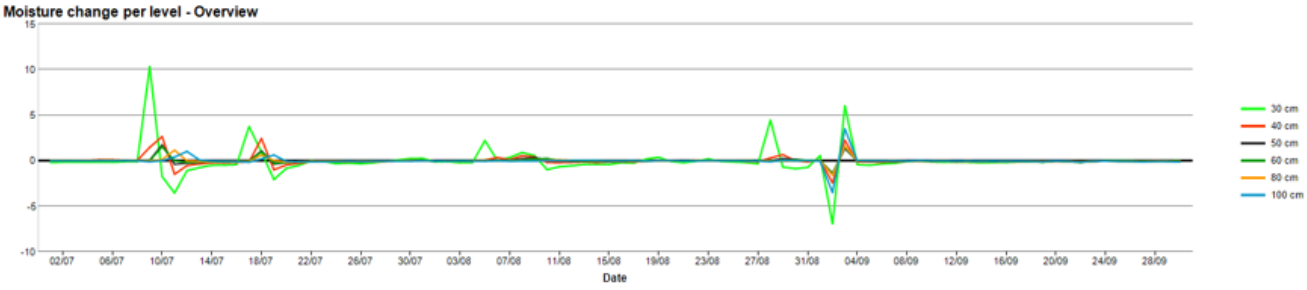
Select From Date 01/07/2016 To 30/09/2016 Go Export

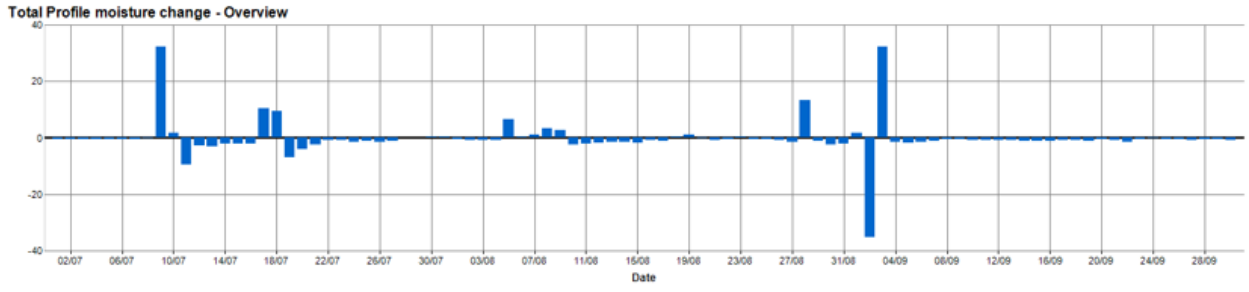


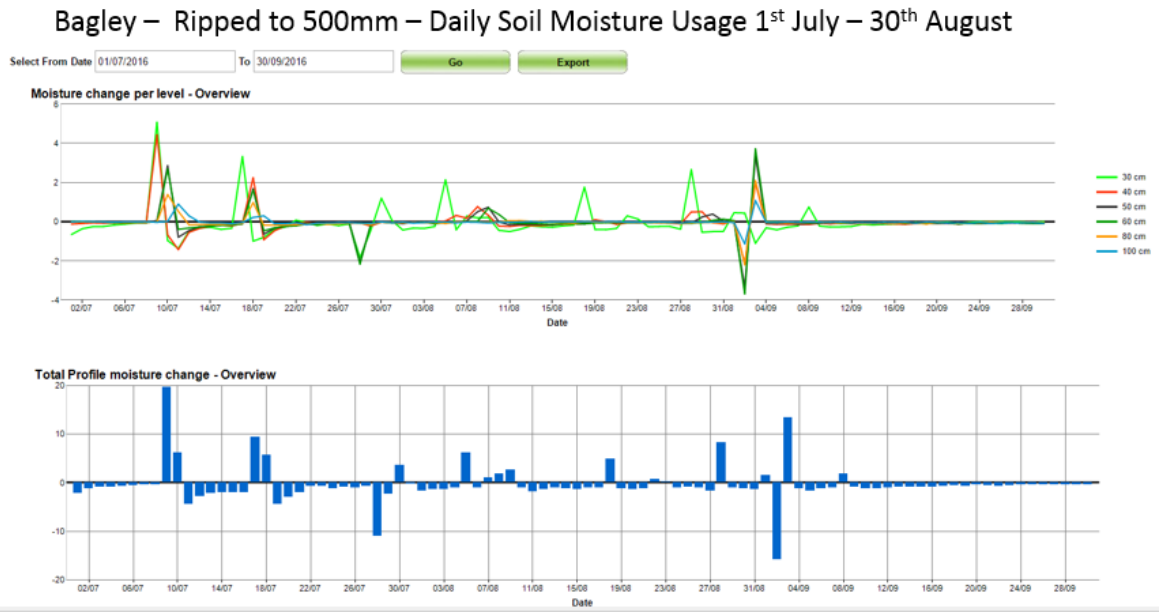


Bagley – Ripped to 300mm – Daily Soil Moisture Usage1st July – 30th August

Select From Date 01/07/2016 To 30/09/2016 Go Export







Comments:

Yield was increased with deeper ripping in wheat on sandy soils at Eradu and Walkaway and in canola at Arrino.

The 400kg response to deeper ripping at Eradu to ripping to 350mm (current standard practice) is very encouraging as it was the second year of ripping and third year of wheat on wheat. About a 400kg/ha response was also observed in the first year of ripping, that was 600kg/ha higher than the unripped treatment.

At Walkaway deeper ripping and topsoil slotting was the highest yielding treatment. Visual observations showed more plant roots deeper in the slots than unripped and NDVI measurements indicated a higher biomass in the deeper ripping treatments during the season.

There was a yield penalty of ripping in lupins at Ogilvie. There was some plant establishment challenges seeding into soft soil in the deeper ripping treatment however this is not thought to be the only reason. There were more plant roots at depth in the ripping treatments and the lupins were greener and flowering longer however this did not translate to yield. A similar negative response to ripping with slots was found in lupins at two DAFWA trials in the NAR region. These lupins were seeded towards the end of May. Other growers in the NAR observed a benefit of deeper ripping and inclusion plates where lupins were sown at the beginning of April. More investigation is required to determine why this is occurring as the negative effect on gross margin is considerable.

At Mullewa the shallow ripping yielded the highest. The reason for this is not clear. There were some plant establishment problems in the deeper ripped soil due to the soil surface being higher in the spraying tramlines. This did reduce plant number however tiller counts indicated the plants compensated accordingly. The same number of spikelets were counted in the three treatments. A possible reason for the yield difference may be the deeper ripped treatment was affected by frost more so than the other treatments if the crop development was slightly delayed with the uneven plant establishment and access to more moisture (the crop held on longer at maturity) that may have reduced grainfill.

Seeding indicated challenges achieving even seed depth control in very soft deeper ripped soils at Ogilvie and Mullewa. At Ogilvie the bar wheels in the seeder wing kept bogging and bulldozing. To overcome this issues Ben dropped the tyre pressure and locked the castor wheels of the bar wheels. At Spring park farms sinkage in the spraying tramlines and lifting of the soil surface have left a hump between the tramlines that caused uneven seed depth reducing plant numbers. Messinas are going to renovate and smooth the tramlines this season. Towing a weight roller behind the ripper will help firm the seed bed post ripping.

Evaluation of soil moisture probe data has identified changes in the pattern of soil moisture usage. Depth and speed of soil moisture usage increased with the depth of ripping. Soil moisture infiltration after a rainfall event was quicker on the ripped plots at all sites and the deeper ripping seemed to have the fastest infiltration of soil moisture after a rainfall event.

The canola crop sown on the Bagley site at Arrino which was sown in early April visually produced more biomass with the increased depth of ripping. The higher crop biomass utilized more soil water during the season, but also drew more soil water from deeper in the soil profile. Visual inspection of plant roots mid flowering indicated greater root growth in the top 30cm under the deeper ripped plots. Although not measured the pattern and depth of soil water usage indicated that there was greater canola root biomass deeper in the soil profile. The increase in root biomass at depth resulted in more soil moisture being extracted from deeper in the soil profile.

Canola on the 500mm deep ripped plots at the Arrino site flowered for longer and stayed green for longer which also translated into an increase yield and total soil moisture usage.

Soil moisture probes have indicated that accumulated soil moisture usage has been increased with the depth of ripping at all sites. Soil moisture will be monitored during the second year of this project to identify whether the depth of ripping has an effect on the PAWC of the soil. It may be that the PAWC does not actually change but rather the depth of which PAW is drawn from is increased, which would indicate that removal of compaction promotes more root biomass deeper in the soil profile allowing soil moisture to be drawn from deeper in the profile, effectively increasing the depth of the soil water bucket.

The increased plant biomass and faster soil water removal under the deeper ripped plots with some crops such as lupins and to a lesser extent canola may be detrimental in some seasons due to increased early biomass and less water left later in the season to promote longer flowering and subsequent pot set. It is commonly seen high biomass and longer flowering lupin crops do not translate into increased pod set. The soil moisture probes indicated that moisture was being drawn from a greater depth under the deep ripped plot. Soil moisture probe data also indicated that the surface soil moisture was depleted quicker with the deeper ripping, if no sub soil moisture is available then this could also result in a detrimental effect in some seasons

More work needs to be conducted to understand changes in root architecture as a result of depth of ripping due to the removal of compaction as a sub soil constraint and its impact on different crop types.

Acknowledgements:

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