GER9 Deep ripping, 'deeper' deep ripping & water use efficiency

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Project Objectives

Growers and advisers have a better understanding of the benefits of deep ripping and the depth of deep ripping required to optimise crop yield & profit. They also better understand where the cost of ripping is more economic (rainfall zones, soil types) and very importantly how long the benefit lasts for in a CTF system.

Growers and advisers will be able to assess the likely cost-benefit to them/their clients of deep ripping.

Method

Five large scale deep ripping demonstration sites on different soil were established in 2016 pale sand Walkaway, red loam Mullewa, yellow loamy sand Arrino, yellow deep sand Eradu and yellow sand at Ogilvie. Three treatments were applied unripped, shallow ripping 300-350mm and deeper ripping 420-600mm. Permanent inseason soil moisture capitance probes were installed in the rip line of the three treatments at each site to assess changes in soil water use with deep ripping. Unfortunately, the supplier and hardware proved unreliable and failure to support the technology meant little useful data was collected. An alternative method to using a Water Diviner 2000 via access tubes installed in the rip lines was used to monitor soil moisture periodically in 2017.

Results summary

The yield results for 2016 and 2017 and the 2017 soil moisture data is presented here. For a complete summary and interpretation of results see GRDC Final report GER9 Deep ripping, 'deeper' deep ripping & water use efficiency.

Yield 2016 and 2017

Table 1. Average yield t/ha of deeper ripping sites Geraldton Port Zone 2016 and 2017 (Shallow <350mm ripping, Deep 420-600mm ripping, Deep+ = 600mm ripping + wings or topsoil inclusion)

	2016				2017		
Site	UR	Shallow	Deep	Deep +	UR	Shallow	Deep	Deep+
Yellow sand Ogilvie	3.53	3.05	2.61		2.05	2.14	2.28	
Yellow loam Arrino	3.05	3.24	3.70		2.08	2.29	2.58	
Pale sand Walkaway	1.69	2.27	2.59	2.80	0.92	1.23	1.34	1.38
Red loam Mullewa	3.30	3.62	3.43		0.85	0.87	0.84	
Yellow sandplain Eradu		2.24	2.57	2.72		2.38	2.55	2.3
Average	2.89	2.88	2.98	2.76	1.47	1.78	1.92	1.84
St dev.	0.71	0.55	0.49	0.04	0.59	0.61	0.70	0.46

Table 2. Average yield response % of deeper ripping sites Geraldton Port Zone 2016 and 2017 (Shallow <350mm ripping, Deep - 420-600mm ripping, Deep+ - 600mm ripping + wings or topsoil inclusion)

	2016			2017		
Site	Shallow	Deep	Deep +	Shallow	Deep	Deep +
Yellow sand Ogilvie	-14	-16		5	11	
Yellow loam Arrino	6	21		10	24	
Pale sand Walkaway	34	53	66	34	46	50
Red loam Mullewa	10	4		2	-1	
Yellow sandplain Eradu*		15	16		7	-3

*Eradu – There was no unripped treatment at Eradu in 2016. The ripping response is looking at the deeper ripped compared to shallow ripped

Table 3. Gross margin of deeper ripping sites Geraldton Port Zone 2016 and 2017 (Shallow = <350mm ripping, Deep = 420-600mm ripping, Deep+ = 600mm ripping + wings or topsoil inclusion) (Grain price lupins $280/t, canola $550/t, wheat $270/t, cost of ripping - shallow $45/ha and deep $80/ha)

	2016				2017			
Site	UR	Shallow	Deep	Deep +	UR	Shallow	Deep	Deep+
Yellow sand Ogilvie	$0	-$224	-$418		$0	$24	$62	
Yellow loam Arrino	$0	$58	$271		$0	$57	$135	
Pale sand Walkaway	$0	$111	$163	$220	$0	$87	$118	$129
Red loam Mullewa	$0	$43	-$43		$0	$11	-$5	
Yellow sandplain Eradu		$0	$11	$49		$0	-$48	-$22

Table 4. Cost benefit Ratio ($/Ha) for deeper ripping sites Geraldton Port Zone 2016 and 2017 (Shallow = <350mm ripping, Deep = 420-600mm ripping, Deep+ = 600mm ripping + wings or topsoil inclusion) (Grain price lupins $280/t, canola $550/t, wheat $270/t, cost of ripping - shallow $45/ha and deep $80/ha)

	2 Year Cost benefit Ratio (2016 & 2017) $/Ha			
Site	UR	Shallow	Deep	Deep +
Yellow sand Ogilvie	0%	-$4.45	-$4.44	
Yellow loam Arrino	0%	$2.54	$5.08	
Pale sand Walkaway	$0	$4.39	$3.50	$4.37
Red loam Mullewa	$0	$1.19	-$0.61	
Yellow sandplain Eradu		$0	$0.73	$0.34

Soil moisture observations 2017

The graphs for 2017 have been generated from the soil moisture measurements taken from the Soil Moisture Diviner through the 2017 season (July – October), and show the average soil moisture for 0-100cm, 10-30cm, 40-60cm and 90cm, for each sampling time by ripping treatment. Rainfall in mm recordings are shown by the blue columns.

Ogilvie - Yellow sand

The first major rainfall event for the season was recorded just prior to the August 14th sampling date hence all treatments showing similar soil moisture profiles (Figure 6). There was less moisture left in the soil profile from 0-100cm at the end of the season in the deeper ripped treatments. The deeper ripped treatment also has less soil moisture than the unripped and ripped to 300mm treatments at the end of September at 40-60cm. At this time the ripped to 300mm and unripped had a similar amount of water. The average soil moisture content of the three treatments in the 70-90cm zone did not vary much over the season.

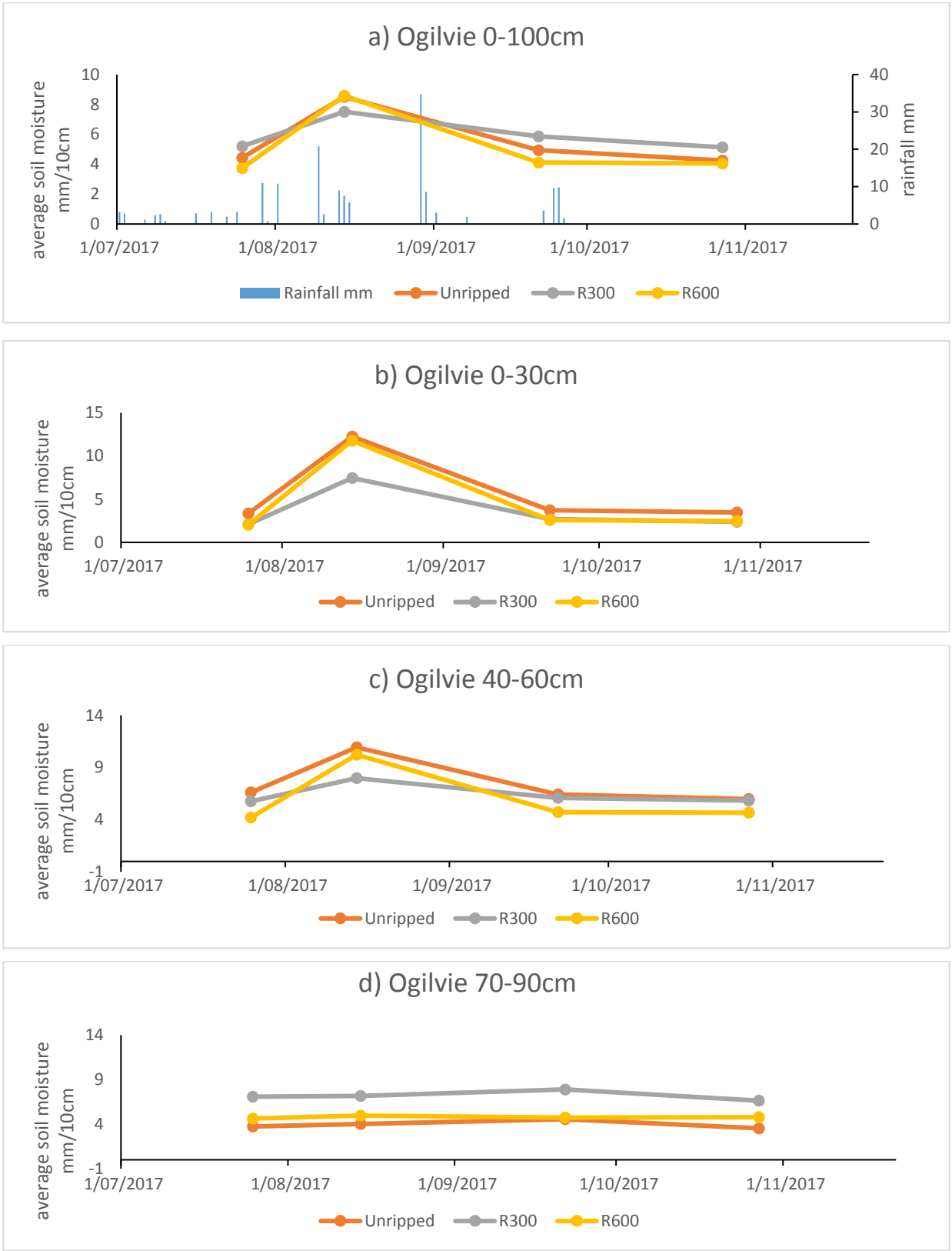


Figure 6. The average soil moisture per 10cm increments to a) 0-100cm b) 0-30cm c) 40-60cm and d) 70-90cm yellow sand at Ogilvie 2017

Arrino - Yellow loamy sand

In 2017 there was more soil moisture in the R600 treatment the other treatments until the final sampling., suggesting the plant roots in the R600 treatment had extracted more water over the 100cm profile (Figure 8). The UR and R300 treatments had similar soil moisture profiles all season in the 0-30 and 30-60cm depths but the R300 treatment had higher average soil moisture content at 70-90cm.

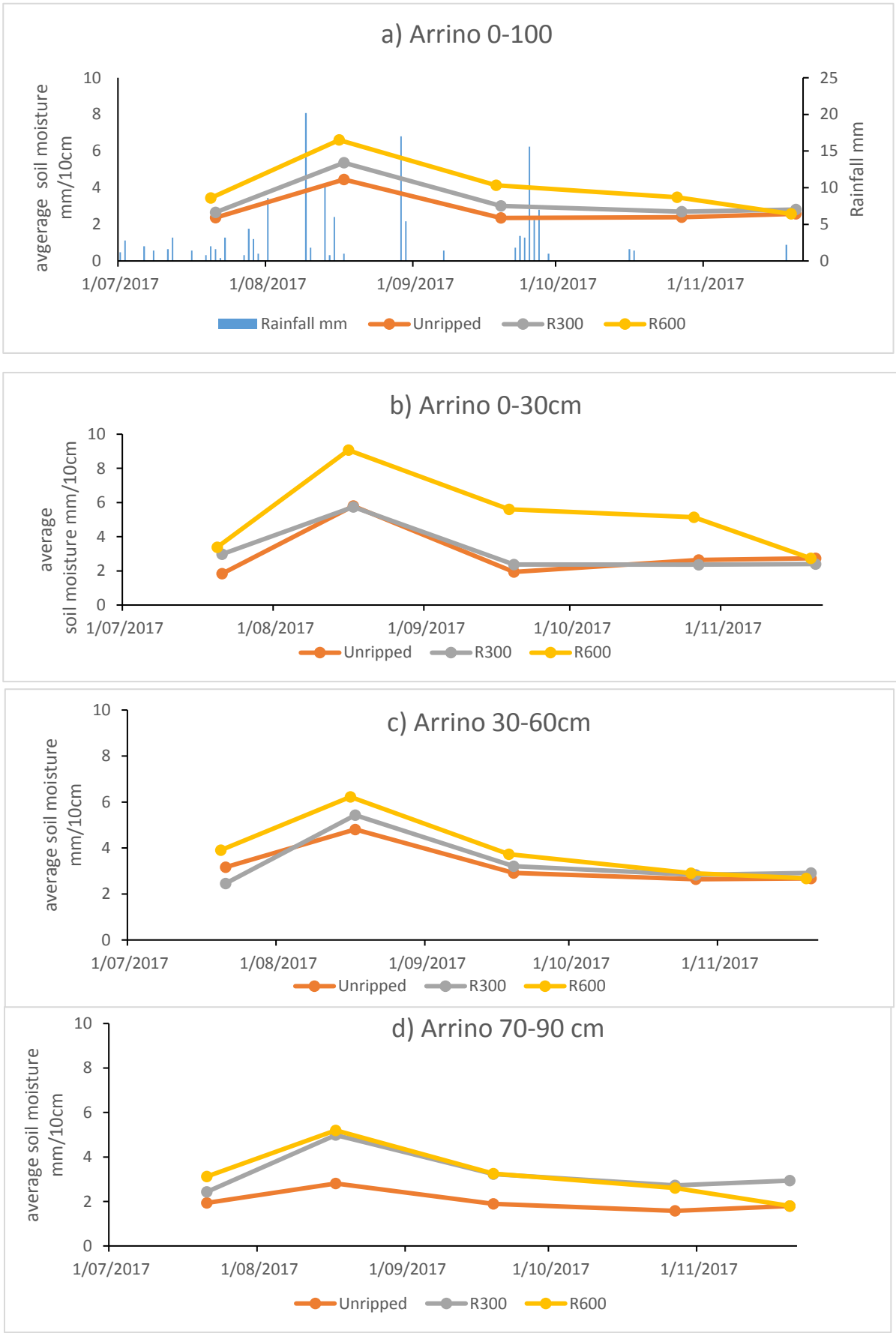


Figure 8. The average soil moisture per 10cm increments to a) 0-100cm b) 0-30cm c) 40-60cm and d) 70-90cm yellow loamy sand at Arrino 2017

Note. The total volumetric soil water decreases as the season progresses under the deeper ripped treatment, indicating a greater total soil moisture drawdown compared to the pattern with the shallow or non-ripped treatments, which did not utilise as much of the total soil water (Figure 9).

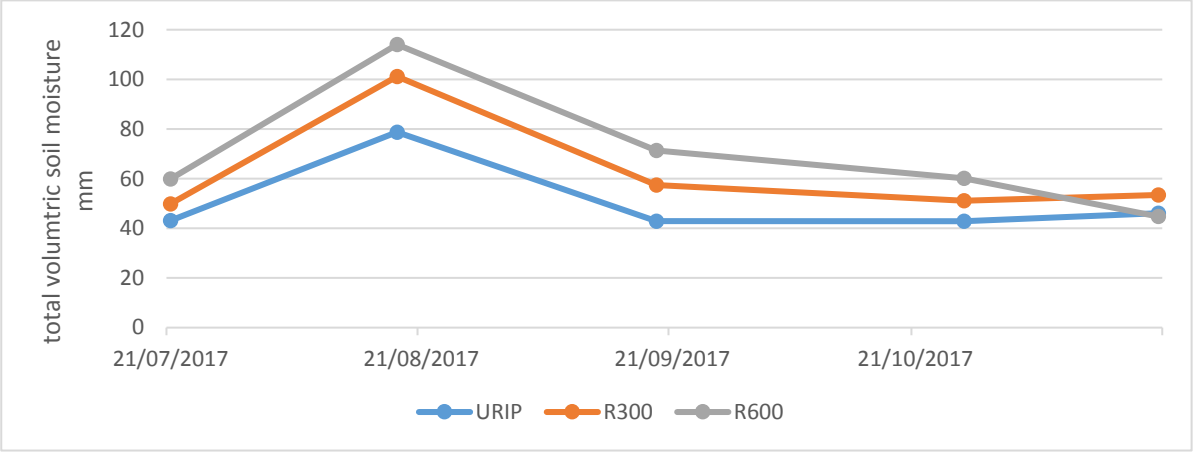


Figure 9. Total volumetric soil water 0-100cm yellow loamy sand Arrino

Eradu - Yellow sandplain

Soil moisture data collected by the Water Diviner showed there was more soil moisture in the R600 treatment than the shallow ripped treatment and more moisture deeper in the profile (Figure 10). Note that at this site we are comparing, 300mm ripping to 600mm ripping treatments only as there is no unripped plots at this site in 2016 and 2017.

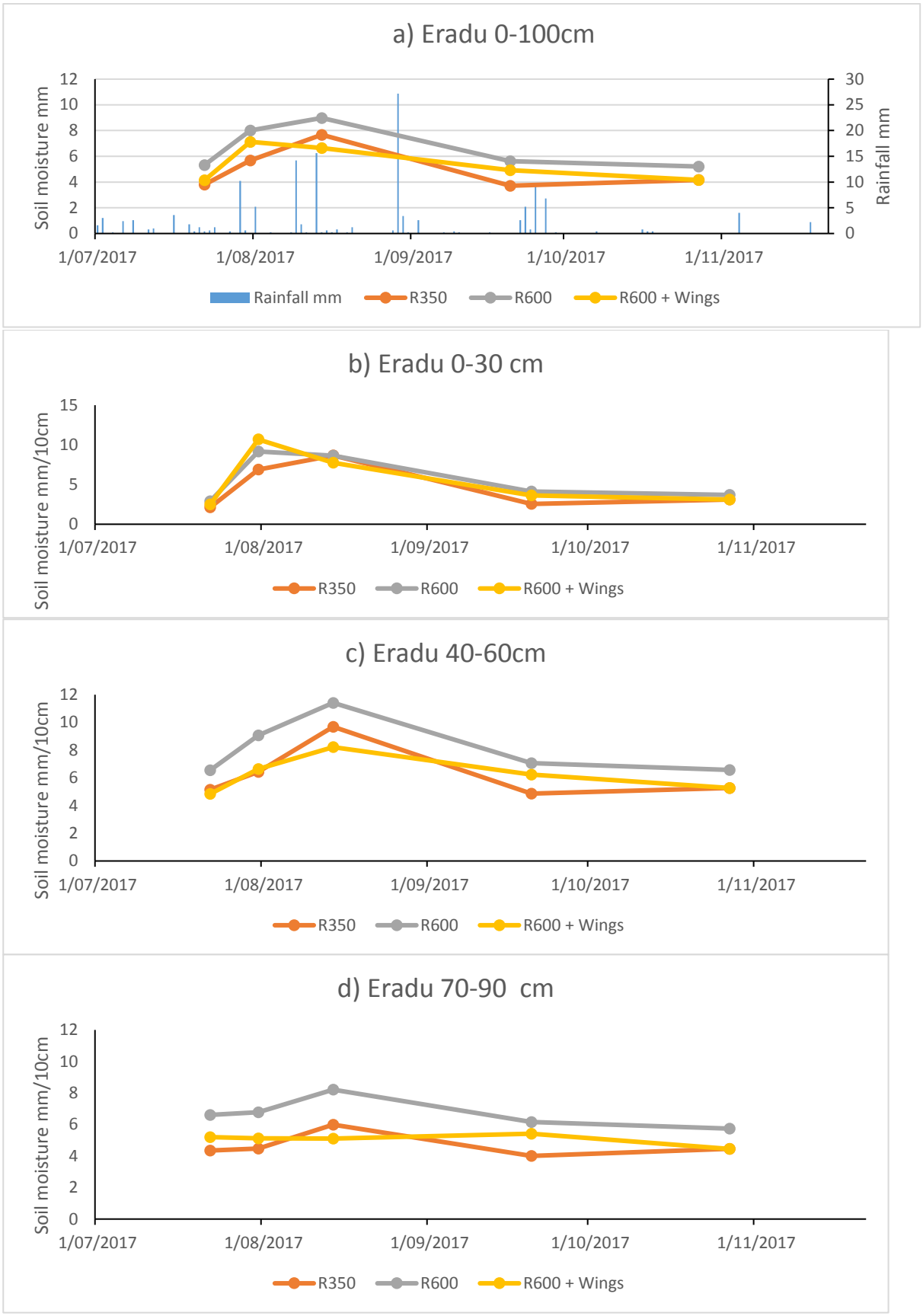
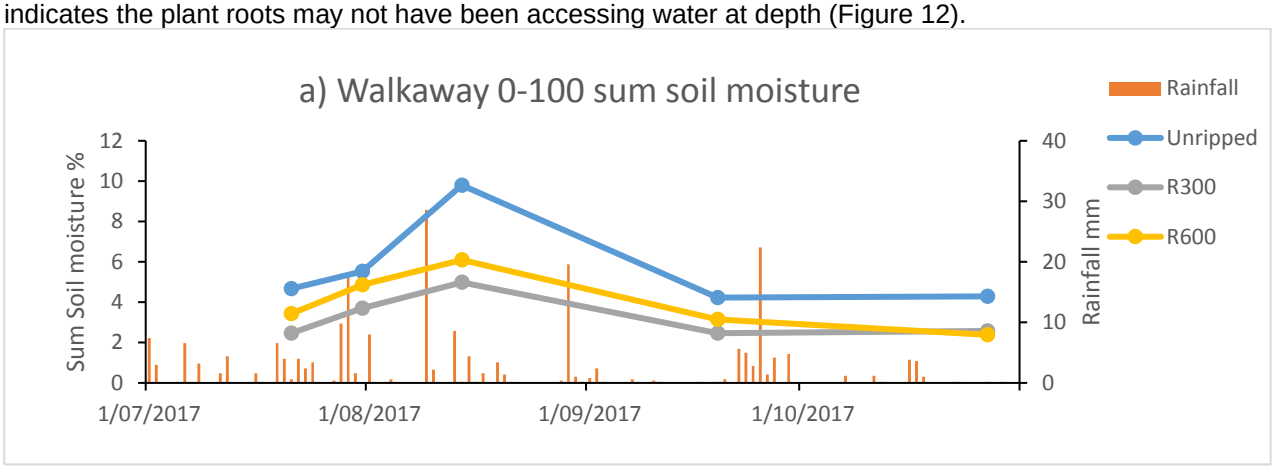
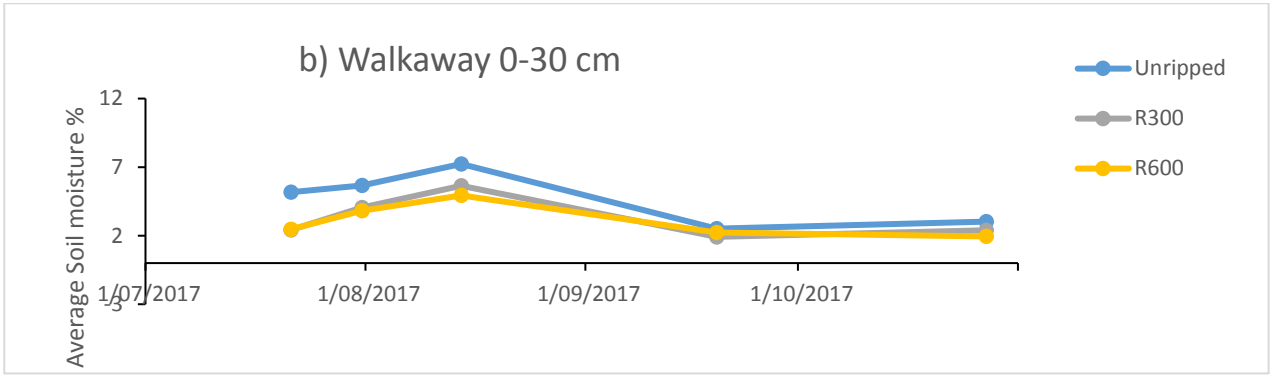


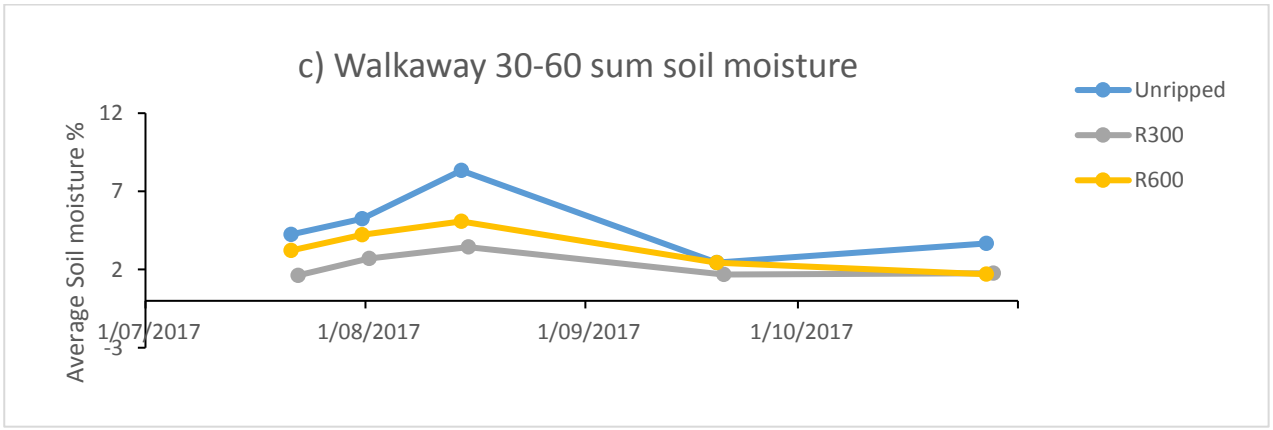
Figure 10. The average soil moisture per 10cm increments to a) 0-100cm b) 0-30cm c) 40-60cm and d) 70-90cm deep yellow sand at Eradu 2017

Walkaway - Pale white sand

There was more moisture in the soil profile to 1m throughout the season in the unripped treatment. This was supported by visual observations; digging holes during the season under the lupins and seeing more moisture in the unripped treatment. The higher moisture content in the unripped treatment on 14 August indicates the plant roots may not have been accessing water at depth (Figure 12).







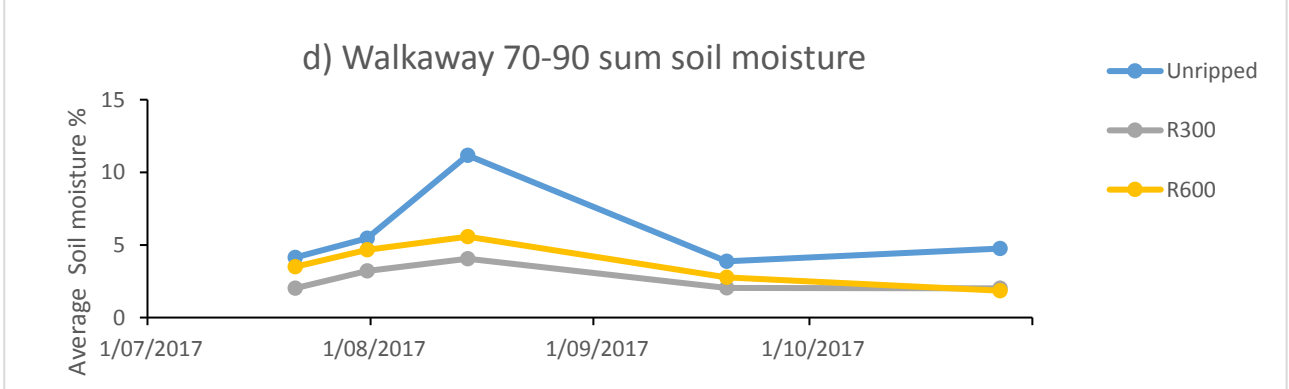


Figure 12. The average soil moisture per 10cm increments to a) 0-100cm b) 0-30cm c) 40-60cm and d) 70-90cm deep yellow sand at Walkaway 2017

Mullewa - Red loam

On the 22 July 2017, there was more soil moisture at depth in the ripped treatments compared to the unripped treatments, this was prior to the first main rainfall event for the growing season (Figure 15). The shallow and deeper ripped treatments had similar moisture content at the start of the season but the deeper ripped treatment had less moisture at the end of the season. The unripped treatment had greater variation in soil moisture than the ripped treatments. The average soil moisture contents for the red loam were much higher compared to the other four sites that have sandy profiles.

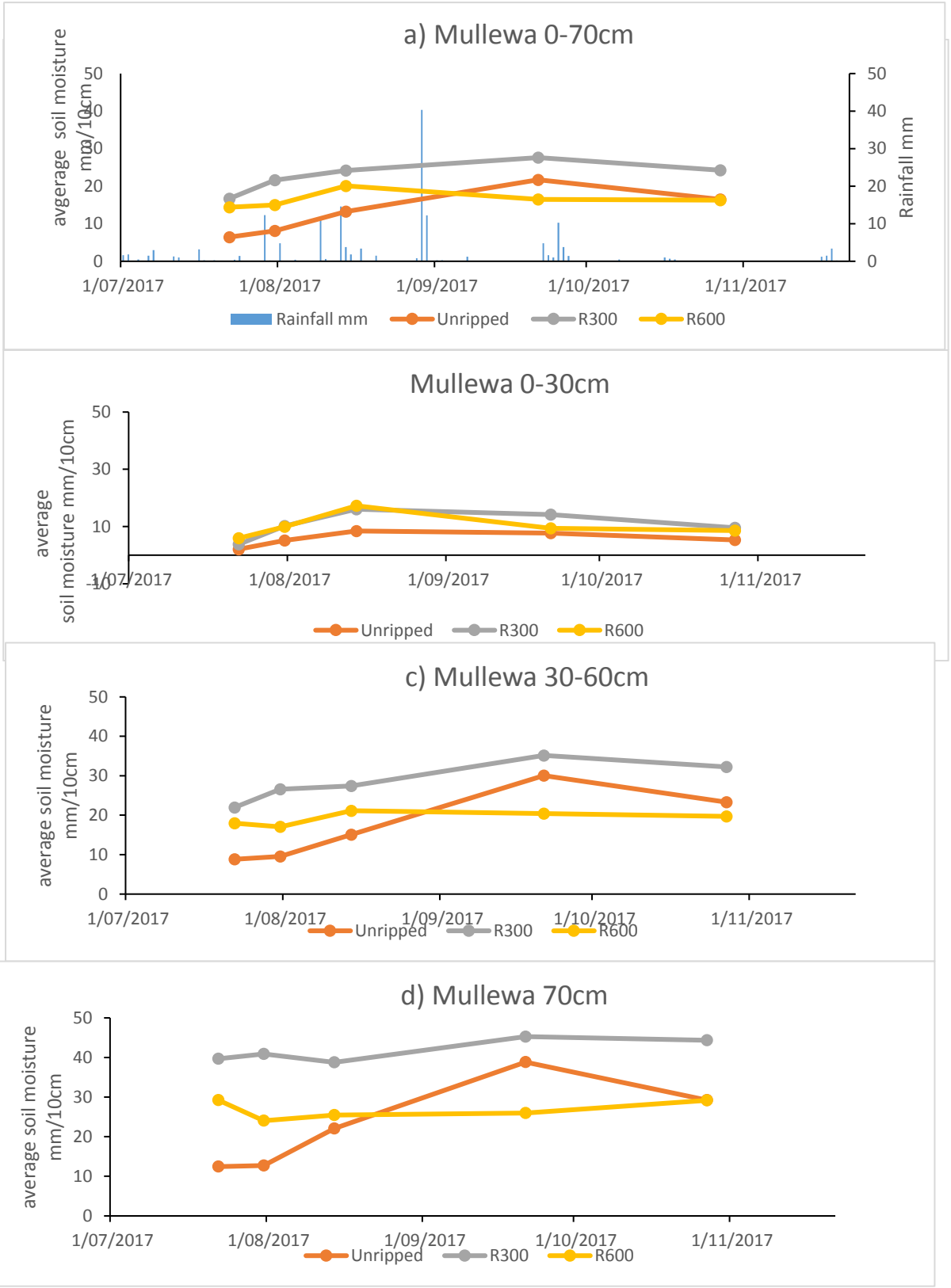


Figure 15. The average soil moisture per 10cm increments to a) 0-70cm b) 0-30cm c) 40-60cm and d) 70cm deep red loam Mullewa 2017

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