Deep Ripping Dry Compact Sand in Two Bites

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Key Messages

- Deep ripping dry sand was more effective with two passes (or shallow leading tines); less cloddy.
- Yield benefits of 410 kg/ha (18%) from deep ripping were mainly due to better head fill. Better head fill was probably due to better cooling of the crop in hot weather due to better supply of moisture.
- Extra moisture seemed to be from rain which infiltrated deeper in the ripped soil to avoid more evaporative loss than the unripped soil.
- A controlled traffic system will better protect the investment in deep ripping and extend the benefits. Deep ripping costs will also be reduced when the permanent tramlines are left unripped; seeding can also be easier with better flotation on permanent tramlines.

Aim

To demonstrate more efficient deep ripping of a dry compact sandy soil and to assess any benefits of improved rain infiltration and crop yield.

Background

Compression stresses from cropping machinery are becoming greater and deeper in our cropping soils as farm machinery increases in size and capacity to improve efficiency. This is due to increasing loads on axles, wheels and tracks. Such effects are of most concern on sandy soils which need depth to compensate for relatively low water holding capacity, compared with soils of higher clay content. Deep ripping provides a method of breaking up compacted soil, but greater depth of ripping encounters the problem of soil overburden pressure. Soil overburden pressure is the weight and tightness of soil above the penetrating point of a ripper, which can restrict the bursting out of soil towards the surface and restrict soil failure to a slot. Shallow leading tines that rip at two depths in one pass minimise this problem. Deep ripping when the soil is dry is also a convenient time in the cropping cycle, compared with when rain occurs and other operations will become a priority. Previous research has found shallow leading tines can reduce fuel use and minimise large clods when deep ripping, especially to depths below 300mm.

Trial Details

Property	Fitzsimons Property, east Buntine
Plot size & replication	3m x 40m x 4 replications
Soil type	Sand over gravel
Soil pH ($CaCl_2$)	0-10cm: 4.5 10-20cm: 4.1 20-40cm: 4.7
EC (dS/m)	0.117 dS/m
Soil Amelioration	24/04/2014: Deep ripped in dry conditions using a Yeomans farm ripper (centre section) with towed rubber tyred roller; subsoil moisture content 5-7% v/v. The Case Steiger 435 HD used 40-45 L/h of fuel (41-46% engine power and 5-7% slip at 4.5kph) when ripping to 350-400mm in one pass. For the 2 bite system the tractor used 42-45 L/h of fuel (42-45% engine power and 4-5% slip at 4.5 kph) in a second pass to 400-450mm after a first pass using 28-30 L/h (30-38% power and 2-3% slip at 4.5 kph) ripping to 250-275 mm depth. 5 tines at 500mm spacing were used in all cases. No shear pins failed when ripping the plots. The front rank of tines was set at about 40mm shallower than the rear tines to reduce draft on the leading tines in all runs.
Sowing date	03/05/2014 with farm Morris airseeder
Seeding rate	50 kg/ha Calingiri
Paddock rotation	2010: wheat, 2011: wheat, 2013: lupin
Fertiliser	03/05/2014: 30 kg/ha DAPSCZ, 5.3 L/ha CalSap®, 1% Sulphate of Ammonia 05/06/2014: 40 L/ha UAN 09/07/2014: 30 L/ha UAN
Herbicides	03/05/2014: 1.8 L/ha Trifluralin, 1.5 L/ha Gramoxone, 275 g/ha Diuron, 0.3% LI 700 05/06/2014: 350 mL/ha Paragon, 50 mL/ha Alpha-cypermethrin, 30 g/ha Lontrel, 4 g/ha Metsulfuron
Growing Season Rainfall	180mm

Results

Table 1: Yield, screenings and some yield components at east Buntine, 2014.

Treatment	Biomass (t/ha)	Yield (t/ha)	Screenings (%)	Heads (m^2)	Yield/head (g)	1000 grain weight (g)
Unripped	4.95[a]	2.27[a]	0.50[a]	67.0[a]	0.034[a]	41.42[a]
One Rip	5.59[a]	2.69[b]	0.79[b]	70.4[a]	0.039[b]	42.83[a]
Two Rips	5.51[a]	2.67[b]	0.45[a]	70.7[a]	0.038[b]	42.79[a]
LSD (95%)	0.64	0.34	0.29	9	0.0027	2.028

Deep ripping by either method increased yield by 410 kg/ha or 18%. Most of this yield improvement came from more grains being filled in the heads of the deep ripped crop, shown in the 13% increase in yield/head. This probably came from better water supply to cool the crop in hot weather than from water to fill the grains. Grain weights and screenings in unripped and ripped treatments were not as different as yield/head; probably helped by grain fill from rain late in the growing season.

Surface Cloddiness

The two bite ripping showed less surface clod and the one bite more surface clod, as found in the previous research: http://www.giwa.org.au/_literature_125845/Hamza,_Mohammad_et_al_-_Significant_reduction_in_specific_draft_when_ripping

Plant Establishment

There were 147 plants/m^2 established in the nil treatment, 96 in the two rip treatment and 97 in the one rip treatment (standard error 13). Thus there were significantly less plants in the ripped treatments, but enough for a profitable yield, although there were some bare patches that would enable weed development. This was caused by the ripped soil being softer and supporting the seeder presswheels less than the unripped soil.

Soil Strength (at field capacity)

Penetration resistance measured on 11th July showed the pattern in Figure 1.

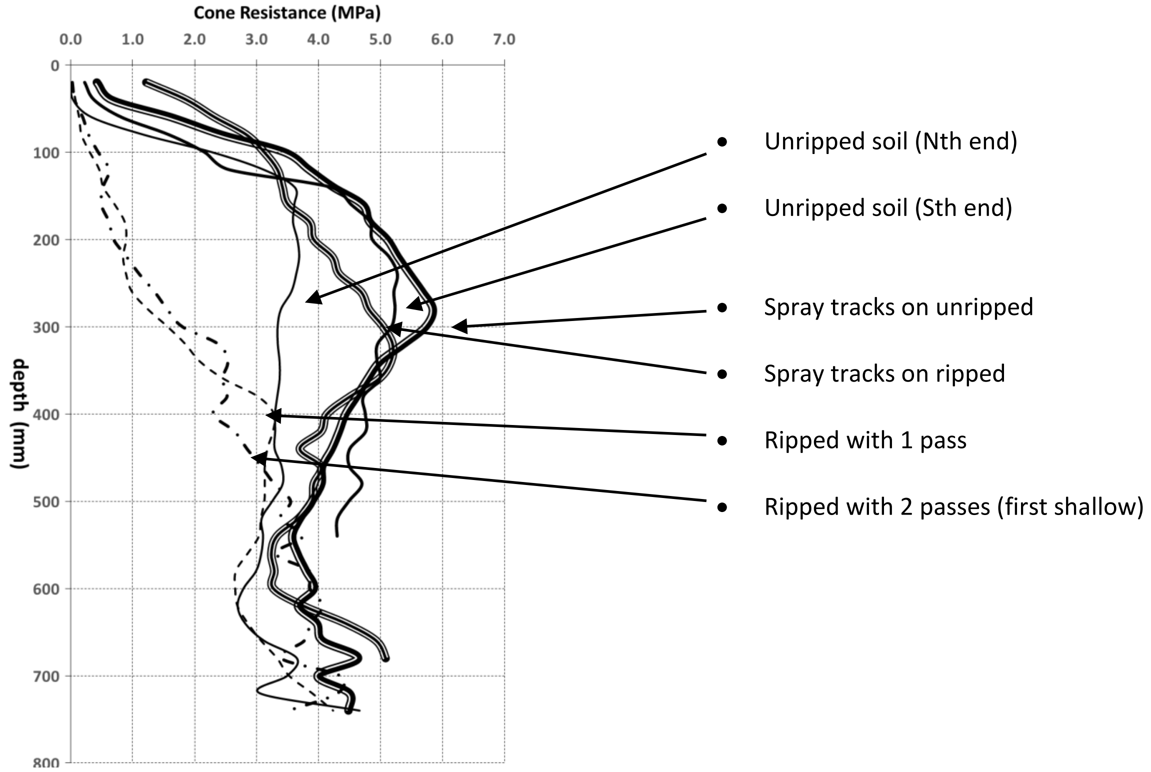


Figure 1: Cone resistance profiles.

A cone resistance of about 3.5MPa is usually enough to stop wheat root growth. Much of the crop roots in the paddock may be constrained to about 200mm depth at best. Either method of ripping has removed the constraint within 400mm depth, but a few passes of normal spraying traffic is enough to reverse the benefits in the first season and compromise long term benefits of deep ripping. Controlled traffic can help to maximise the benefits of investing in deep ripping by minimising recompaction in subsequent seasons. These earthy sands can also show ability to recompact over a number of seasons by the forces induced by wetting and drying but controlled traffic will minimise the need to use deep ripping to correct this.

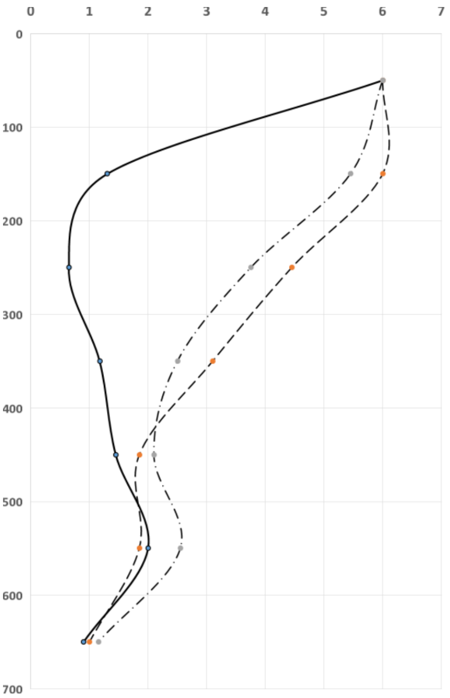
Root Distribution (from visual estimates in trench 12th August)

The side of the trench was exposed to view roots and a weldmesh guide was used to estimate root abundance at 70mm intervals. The photos in Figure 2 show an unripped plot and a deep ripped plot from each of the two deep ripping treatments. There did tend to be more topsoil incorporation with the shallow leading tine (two pass treatment), but the effect did not seem as extreme as can be achieved by a spader or deep working discs.

Unripped   Deep ripped one pass   Deep ripped shallow then deep

Figure 2: Root abundance profile photographs.

The root estimate is shown below for mean values of the four replicates; 6 = abundant roots, 3 = common roots, 1 = few roots, 0 = no roots. In the unripped soil most of the visible roots from 10 - 20cm were in biopores.



Root abundance estimate by depth in mm.

Solid line = unripped
Broken line = ripped in one pass
Dash and dot line = deep ripped with shallow first pass

There is no real difference between the estimated root abundance of the two methods of deep ripping.

Figure 3: Root abundance graph.

Soil Moisture Changes

CSIRO installed recording soil moisture sensors (FDR probes) on June 12th. Each probe consisted of two metal wires 300mm long and 3.2mm in diameter installed horizontally from a pit face at depths of 5, 20, 40, 60 and 80cm. Probes were installed in two replicates of each treatment. Soil moisture was monitored in each probe at 15 minute intervals commencing on June 12th and continued until probe removal on October 22nd to help analyse soil moisture extraction patterns. The early data collected up to August 13th showed evidence of more uptake from the two ripped plots compared with the unripped plot at a soil depth of 20cm. From July 8th to August 13th, uptake was 1.4, 7.0 and 3.6mm from the unripped, ripped once and ripped twice plots respectively. However, there were no differences between the treatments in terms of their water uptake from soil depths of 40cm or deeper. These differences are generally consistent with differences in root abundance (Figure 3).

Despite the differences in yield, differences in patterns of soil water uptake over the whole growing season were difficult to discern (Figure 4). Whilst there was some evidence of lower water content in the ripped plots at depths of 60 and 80cm, the parallel lines for the unripped and ripped plots suggests that this is more likely due to random differences in soil texture and gravel content, rather than a genuine treatment difference. Another interesting difference was observed for soil at 5cm from the surface, where water content was higher in the unripped plots than in the ripped plots. This is probably due to soil disturbance affecting the ability of the topsoil to hold water, which is supported by the lack of response to rainfall events at 20cm in the unripped plots. In other words, rainfall penetrated deeper into the soil in the ripped plots, which could potentially affect evaporation losses and may partly explain the observed yield differences.

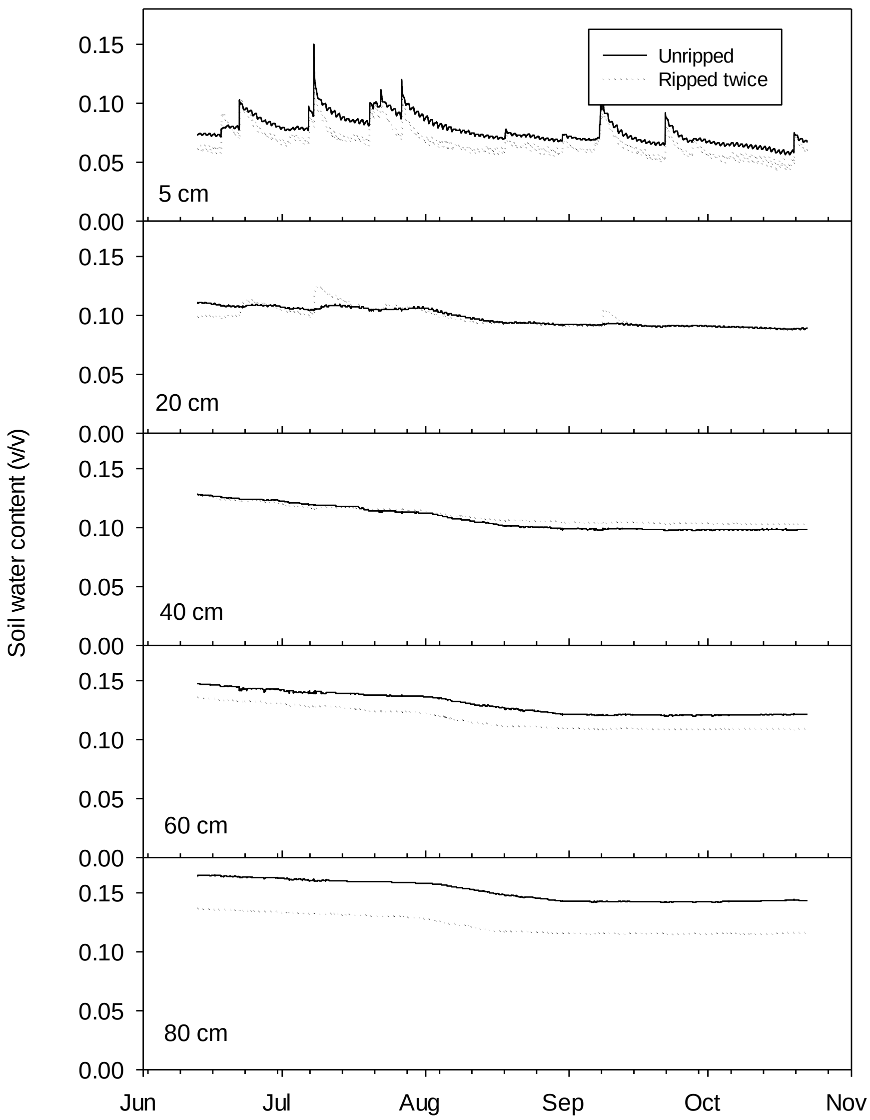


Figure 4: Soil water content changes with time at different depths.

Comments

- Deep ripping dry sand was more effective with two passes (or shallow leading tines) because the surface finish was less cloddy, allowing more reliable seed placement. Deeper seed placement in the trial was due to trying to use a common setting of presswheel pressure and frame height for the airseeder. In a whole deep ripped paddock the air seeder would be set up for optimum seed depth in just one condition. From previous research we already know shallow leading tines reduce cloddiness and fuel use; both are challenges to effective deep ripping of dry sand.
- Yield benefits of 410 kg/ha (18%) from deep ripping were mainly due to better head fill. About 12% more yield per head was found. The fewer plants in the deep ripped soil produced more tillers to provide about the same head population as the unripped treatment. Screenings and grain size were about the same, probably due to late rains. Larger yield improvements were found by deep ripping last season at the Liebe site (approx. 1 t/ha or 40%), probably because there was a more severe winter drought then and the benefits of improved water supply from the subsoil were more valuable to reducing drought stress and minimising yield losses.
- Better head fill was probably due to better cooling of the crop in hot weather due to better supply of moisture from rain which infiltrated deeper into the deep ripped soil to avoid more evaporative loss than the unripped soil. The water supply to the crops looked alike in all treatments but there was evidence of rain penetrating deeper in the deep ripped soil. This would be more difficult to lose by evaporation through the soil surface.

- A controlled traffic system will better protect the investment in deep ripping and extend the benefits. Deep ripping costs will also be reduced when the permanent tramlines are left unripped. Seeding can also be easier with better flotation with more of the seeding equipment wheels on permanent tramlines.

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