Evaluation of Spading vs. Deep ripping

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Aim

- To determine if using a rotary spader on a 'good' sandy loam with minimal repellence and good pH profile can damage soil;
- To compare the impacts of spading and deep ripping.

Background

Rotary spading has been shown to be successful at improving crop establishment, growth and grain yield on water repellent sandplain soils, such as deep pale and coloured sands and sandy gravels. In addition, rotary spading loosens compacted soil and provides an opportunity to incorporate lime into acid subsoils. However, the impact of rotary spading of sandy loam soils with minimal repellence and a good pH profile is unknown. To determine this unknown, a trial was set up on 'good' loamy sand, east of Coorow.

Deep ripping is a cheaper and more cost effective means of reducing subsoil compaction than spading, the benefits of deep ripping tend to be greater in wetter seasons where nitrogen leaching is more of an issue. The benefits of deep ripping can be maintained for longer if controlled traffic is used to prevent future compaction.

The deep ripping treatment removes subsoil compaction without significant mixing while the rotary spading removes compaction but also mixes the soil.

Trial details

Property	Catalina Farms, East Coorow
Plot size & replication	16m x 100m x 2 replications
Soil type	Sandy loam
Soil pH ($CaCl_2$)	Topsoil 6, subsoil 5
Sowing date	17/5/11
Seeding rate	60 kg/ha Mace
Fertiliser	17/5/11: 50 kg/ha DAPSZC 17/6/11: 100 kg/ha Urea 4/8/11: 35 L/ha MAXamFLO
Paddock rotation	2009 wheat, 2010 lupins
Herbicides	17/6/11: 1 L/ha Sprayseed, 1.6 L/ha Trifluralin, 35 g/ha Trisulfuran 6/7/11: 350 mL/ha Paragon, 350 mL/ha Bromoxynil
Growing Season Rainfall	329mm

Results

Due to the partial burial of the organic matter in the topsoil, rotary spading tends to decrease the organic carbon content of the top 10cm while marginally increasing it in the 10-20cm layer (Table 1). The soil pH profile did not vary greatly between the treatments with the lowest pH of 4.7-4.9 occurring at the 20-30cm layer (Table 1). While this is not low enough to be a constraint it does indicate the ongoing need to apply lime to prevent further acidification.

Soil loosening and removal of compaction is one of the biggest differences between the treatments. In the untreated control the soil strength became high enough (>2MPa) to significantly slow root growth at 20-30cm (Table 1). In the deep ripped treatment the soil strength at this depth was 39% or 1.5MPa lower at this depth and remained significantly lower at 30-40cm

also. The spader was even more effective at reducing the soil strength in the top 30cm as it does not just create a ripped seam but completely loosens the soil to the working depth, however, it only loosened the soil to 30cm beyond which there was no difference to the control whereas the deep ripping loosened the soil to 40cm (Table 1).

Table 1: Impact of rotary spading and deep ripping on selected soil properties: organic carbon, soil pH and soil penetration resistance in untreated (Control), deep ripped and rotary spaded sandy loam soil, East Coorow 2011. Data is the average of samples taken from 2 replicate treatments.

Soil depth	Organic Carbon (%)			Soil pH ($CaCl_2$)			Soil Penetration Resistance (MegaPascals, (MPa))		
(cm)	Control	Ripped	Spader	Control	Ripped	Spader	Control	Ripped	Spader
0-10	0.30	0.44	0.27	6.0	6.1	6.0	0.4	0.2	0.2
10-20	0.14	0.16	0.19	5.0	4.7	5.1	1.6	1.1	0.5
20-30	0.07	0.09	0.07	4.9	4.6	4.9	3.8	2.3	1.8
30-40	0.10	0.09	0.07	5.4	5.2	5.3	3.6	2.9	3.7
40-60	0.10	0.06	0.13	6.3	5.9	5.7	2.8	2.8	2.8

Spading reduced plant emergence in this trial but had no significant effect on yield (Table 2).

Crop establishment was negatively affected by the cultivation treatments. On average 142 plants/m^2 were established in the untreated control, compared with 114 plants/m^2 in the deep ripped and only 67 plants/m^2 in the spaded (Table 3). Typically where crop establishment is poor in spaded soils it is a result of the seed being sown too deep in the soft soil which can often be exacerbated by wind erosion and furrow infill. Controlling seeding depth when there are variations in soil strength across different treatments can be particularly difficult.

Table 2: Wheat yield and quality on the main trial site after rotary spading and deep ripping.

Tillage treatment	Yield (t/ha)	Protein (%)	Screenings (%)
minimum tillage	4.6	10	2.9
Deep ripped	4.8	9.4	6.9
Spaded	4.9	9.8	5.1
LSD	*NS*	*NS*	*NS*
CV%	*15.5*	*3.4*	*59*

Table 3: Plant germination 10 days after sowing at the Main Trial Site after different tillage methods.

Tillage treatment	Plant m^2
Spader	67 a
Deep ripped	114 ab
Control	141.5 b

Note: Results with the same letter are not significantly different from each other.

Comments

The soil that this trial was conducted on would not normally be considered for spading. The soil does not have non-wetting constraints nor is it highly acidic. Therefore there is little to no advantage to spading the soil and if compaction is the principal constraint then deep ripping is cheaper, quicker and usually still effective. Deep ripping increases the rate of root growth in the top 30 or 40cm of the soil profile and helps the roots keep up with leaching nutrients, principally nitrogen. It is most effective on deep sands and in wetter seasons with a soft finish. The benefits of deep ripping can be maintained if a controlled traffic (tramline) farming system is employed to prevent future compaction after the soil has been loosened.

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