Compaction After Mouldboard Ploughing

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Key messages

- Re-compaction of newly ploughed soil by farm machinery traffic can occur quickly (within 18 months).
- This is the second wheat crop on this site which has shown no benefit to mouldboard ploughing

Aim

To determine if there are any benefits to be gained from mouldboard ploughing a yellow sandplain soil.

Background

Mouldboard ploughing involves a one-off inversion of the topsoil. In this trial, the plough was able to invert the top 30cm, larger ploughs can get deeper. Mouldboard ploughing can help in the control of weeds, burying water repellent topsoil and incorporating lime at depth. Cost of the operation is approximately $100-120/ha (Davies et al, 2012).

The trial was mouldboard ploughed on the 17th June 2012 after receiving 55mm of rain in the previous week. This allowed the soil profile to fill up at least the top 30cm of soil, which is required for the best inversion.

The deep ripping treatment also conducted in June 2012 was included to take into account the ripping effect of mouldboard ploughing and if that was the reason a yield improvement was produced. The paddock was last deep ripped in 2009, therefore it was predicted that there wouldn't be a significant difference in yield between deep ripped and control plots.

Trial Details

Property	Michael & Narelle Dodd, west Buntine
Plot size & replication	100m x 18m x 2 replications
Soil type	Yellow sand
Soil pH ($CaCl_2$)	0-10cm: 6.2 10-20cm: 4.8 20-40cm: 5
EC (dS/m)	0.045 dS/m
Sowing date	16/05/13
Seeding rate	70 kg/ha Corack
Fertiliser	16/05/13: 60 L/ha Flexi-N, 50 kg/ha Ag flow extra, 20 kg/ha MOP, 0.25 L/ha TM21
Paddock rotation	2012: wheat, 2011: pasture, 2010: wheat
Herbicides	16/05/13: 1.8 L/ha Treflan, 1 L/ha Roundup
Growing Season Rainfall	173mm

Results

In 2013 the crop did not respond to deep ripping or mouldboard ploughing in terms of overall yield or quality. The tillage occurred in June 2012 so this is the second wheat crop produced on this trial. The 2012 crop also showed no response to mouldboard ploughing or deep ripping.

Table 1: Wheat yield and quality 18 months after mouldboard ploughing and deep ripping occurred on yellow sand at Buntine 2013. The trial was set up with a no tillage plot termed 'Control' next to each tillage treatment to act as comparison point for this non-replicated demonstration.

Treatment	Yield (t/ha)	% Nearest neighbour control	Protein (%)	Hectolitre weight (kg/hL)	Screenings (%)
Control	2.01	100	11.9	81	2
Deep ripped	2.22	110	11.2	81	2
Mouldboard	2.28	110	12.1	80	2
Control	2.06	100	11.6	81	2
Deep ripped	1.86	90	11.3	79	3
Mouldboard	2.02	95	12.2	80	1
Control	2.11	100	11.4	80	2

This paddock has issues with hard pans and compaction (Figure 1, black line). Root growth is hindered once resistance is above 2 mega Pascal's (MPa) which is the case from depth of 15cm to 50cm. Deep ripping has removed the compaction where the tyne has passed through (Figure 1, grey dashes) however, there is still a lot of hard soil between the rip lines (data not shown). Areas which were mouldboard ploughed 12 months before measurements were taken are equally as compacted as the control which has had no tillage on the basis of these measurements.

Determining if the deep ripping and mouldboarding had removed the compaction layer was very difficult in this soil. The device used to determine compaction is called a penetrometer and needs to be used in wet soil. Soil needed to be wet throughout the profile, and as we were unable to rely on rain events, we tried to wet the soil by hand watering however, this too may not have been enough to fully wet the soil profile and the penetrometer readings may be higher if the soil was still dry.

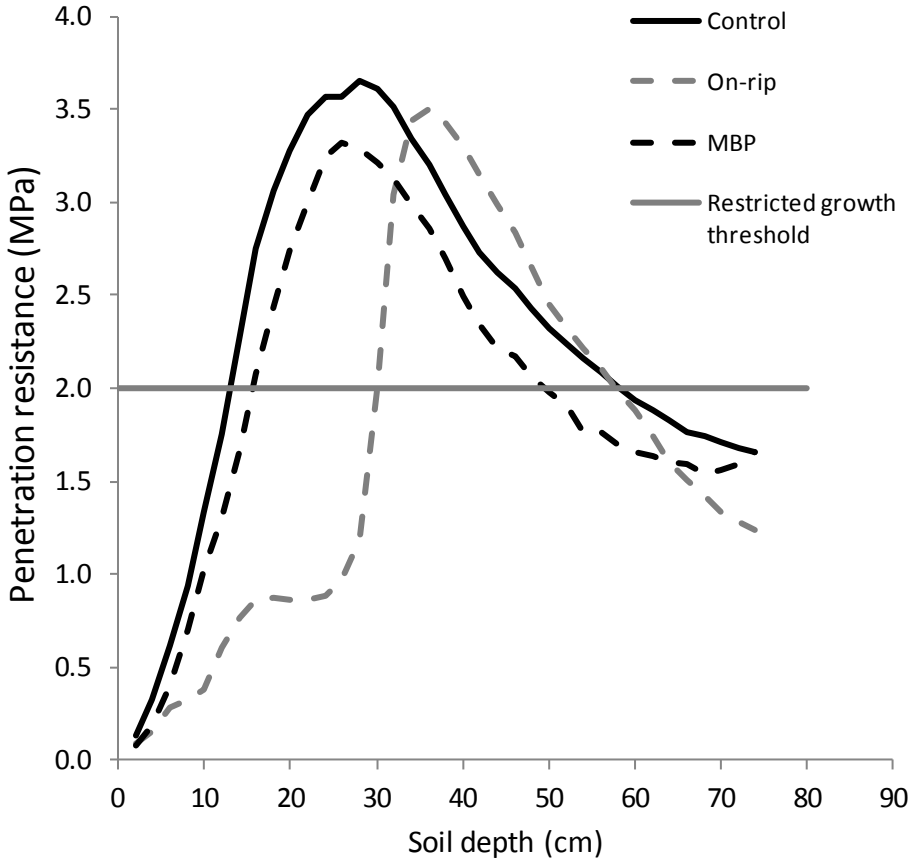

Figure 1: Penetrometer resistance measurements which indicate soil compaction for mouldboard plough, deep ripping and control (no tillage) on yellow sand west of Buntine, August 2013. Root growth can be hindered above 2MPa.

Economic Analysis
In the short term the most economically profitable treatment in this trial was the control with a cumulative gross margin over 2012 and 2013 season of $870/ha. The tillage methods (Deep ripping and ploughing) did not produce large yield gains and therefore have not repaid the implementation cost of the operations, which was $50/ha and $125/ha respectively.

Table 2: Gross margins of mouldboard ploughing compared to deep ripping and control (minimum tillage) on deep yellow sand at Buntine. Determined by grain income minus cost of production. Fixed costs are not included in this analysis. The cost of deep ripping $50/ha and mouldboard ploughing $125/ha was incurred in 2012 only.

Treatment	2012 $/ha	2013 $/ha	Cumulative gross margin $/ha
Control	520	350	870
Deep ripped	470	340	810
Mouldboard ploughed	340	370	710

Grain price used were: 2012 season - $340/t, 2013 - $300/t.

Comments
This soil type has not responded to mouldboard ploughing however, it was not expected to because there was no major constraint limiting grain yield such as water repellent sands, acidic subsoils or a high weed burden.

Compaction is present deep in the soil profile however, compaction may not be as severe as depicted here because at time of measurement soil may not have been completely wet as required. Nonetheless the relative relationship between treatments from these measurements indicates that mouldboard ploughed areas are as compacted as the rest of the paddock. We aim to take more penetrometer measurements at the site next year when the soil profile is wet.

Heavy machinery quickly re-compacting the loose ploughed soil has been seen on other trials and needs to be minimised by using controlled traffic.

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