



### Fact Sheet 16 July 2004

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# Dealing with subsoil compaction in Mallee soils

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## The Issue

In recent cropping seasons, a group of Mallee farmers have observed poor crop growth on sand hills. A range of factors, including shortage of nutrients and diseases were investigated and discarded as major causes of poor crop growth. Eventually soil compaction was identified as a key, previously unnoticed, constraint in this type of soil.

To further investigate the extent to which soil compaction could be impacting on grain yields, deep ripping trials were initiated at Caliph and Loxton, SA. Treatments included ripped and un-ripped strips in large paddocks including both sand hills and sandy loam flats.

## What we know about compaction in Mallee soils

Compaction in sandy Mallee soils is **NOT** a major impediment for downward movement of water through the profile. Subsoil compaction thus operates as a one-way valve – water can move down, but water uptake by plants is restricted.

Compacted soil layers impose a severe barrier for root penetration and water uptake from deep in the soil profile. The accumulation of water below the compacted zone can increase the risk of deep drainage.

## The effect of ripping on Mallee soils

A combination of field and modelling studies indicated three major changes in the fate of water in relation to soil compaction and subsequent ripping.

The process of ripping can:

- increase transpiration, hence plant growth;
- reduce unproductive soil evaporation, thus increasing water use efficiency; and
- reduce the risk of deep drainage through deeper root water uptake.

## What we found out

- Field measurements using a 0.6 m deep probe showed a dramatic reduction in soil penetration resistance in sandy hills (Refer Fig. 1 below).

- The effect was less pronounced in sandy-loam flats. Fig. 1 (below) shows a noticeable peak of soil resistance at about 30 cm of soil depth. This is a serious restriction for root penetration.

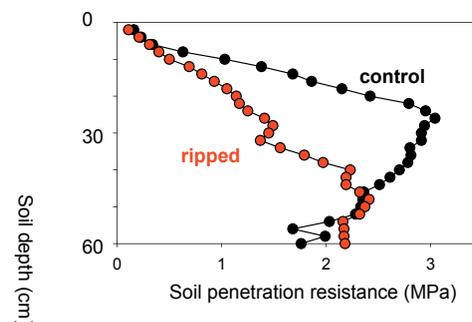


Figure 1: Profiles of soil penetration resistance (in mega pascals) measured in untreated soil (control) and in ripped soil on a sandhill at Loxton. The deep ripping was done with a 3 tine ripper at a depth of approximately 600mm. Ripper tine spacings were 450mm.

- As few roots can go through this compacted layer, water builds up in the soil below this level.

## The effect of ripping on wheat yield, grain protein and profit Trial results

- Yield response to ripping depended on soil type and season. It ranged from 0% in the less responsive sandy-loam flats to a 43% increase in sand hills (Refer Fig. 2 below).

In the more responsive soils, increase in yield was accompanied by an increase in protein content at both sites.



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- **Caliph** -protein content increased from 9.9 to 11.3%
- **Loxton** – protein content increased from 13.7 to 14.6%
- For an APW price of \$179/ton (5-year average), the yield gain required to pay for the cost of deep tillage (\$40/ha) is **223 kg/ha**.

The average yield gain in the trials was **425 kg/ha**. Yield gains ranged from zero in sandy-loam flats up to 870 kg/ha in the most responsive sandy hills (Fig. 2).

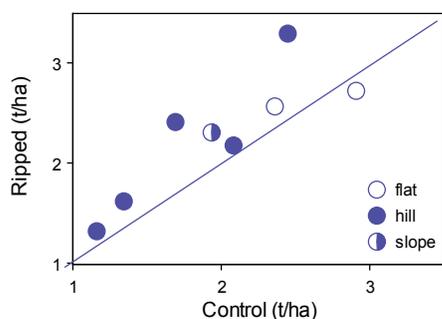


Figure 2: Comparisons of wheat grain yield for crops grown in untreated, compacted soils (control) and soils where compaction was alleviated with deep tillage (ripped). The line represents equal yields.

## What it means for farming in the Mallee

We currently don't know how widespread subsoil compaction is in the Mallee..

However, it is estimated that for each 1% of the total Mallee area affected by compaction, deep tillage could generate a benefit of **\$1 M** per year. (These calculations are based on APW price of \$179/ton, actual cost of deep tillage of \$40/ha, and average yield response of 425 kg/ha).

Preliminary modelling studies indicated the long-term probability of deep drainage events can be reduced from between 2-18% in compacted soil to 0-5% in ripped soil.

Importantly, the benefits of deep tillage seemed to last 2-3 seasons, and there is a potential bonus in the additional protein content.

## Where to from here?

• Currently, there are no diagnostic tools available to assess the extent and magnitude of subsoil compaction. If you suspect this can be an issue in a particular paddock, the simplest test would be to rip a section of the field, and to compare crop growth and yield against un-ripped controls.

• Taking soil cores after harvest can be a useful indicator, as any obvious moisture left in soil layers below 0.4 -0.5 m (particularly on sands) is an indication that there is a limitation to root penetration.

## Acknowledgments

### Thank-you to

- Robin Schaefer, and Dean and Jeanette Wormald for their initiative and support with the field trials;
- Shannon Blandthorn and Andrew Taylor for technical assistance; and
- Grains Research and Development Corporation for funding (projects CS0212, CS0216, MSF1).

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Tine ripper used in field trial.

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