Section Editor:
Roy Latta
SARDI, Minnipa Agricultural Centre

Soils

Modification of Sandy Subsoils on EP

David Davenport and Brett Masters
Rural Solutions SA, Port Lincoln

DEMO

Searching for answers

Location:
Ungarra & Edillilie
Farmer: John Houston, Sam & Jim Snodgrass, Terry Young and Peter Treloar Butler - Ungarra Agricultural Bureau and Edillilie Landcare Group with support from LEADA

Soil Type
Sand over clay

Plot Size
Replicated trials: 1.5 m x 22 m x 3 reps
Demonstration sites: 12 m x 8 m

Key messages

- **In sand over clay soils, bleached A2 horizons restrict root growth.**
- **Incorporation of clay and organic material into the A2 horizons delivered greater dry matter production but yield results varied.**

Why do the trial?

Claying and delving of sandy soils has been conducted in South Australia for over 30 years. Historically the major focus has been on eliminating non-wetting on sandy soils. Recent work on EP and elsewhere has indicated that bleached A2 horizons (light coloured sands with little clay or organic material) in many of these soils are as great if not a greater impediment to production as non-wetting sands. The reasons for this have not been clearly identified but are thought to be related to the very low fertility levels of these horizons, but compaction and low water holding capacity may also play a role. Delving has partially addressed these issues, however more even incorporation of clay through spading has achieved better results. The addition of organic material in this process can deliver even more significant results (refer LEADA update 2009) but results have been inconsistent. These trials and demonstrations have been conducted to provide further understanding of what is driving these responses and how soil modification techniques can be improved.

How was it done?

Sites were established as detailed in Table 1.

What happened?

Houston Ungarra

The Houston site compared District Practice (60 kg/ha 18:20), District Practice with additional N (50 kg/ha applied 17 July 2010) and District Practice with trace elements (3 kg/ha Cu, 3 kg/ha Zn, 5 kg/ha Mn) on areas that were unspaded, spaded in spring 2009 (green manure treatment) and spaded in autumn 2010.

Plant emergence counts were taken in early July with no treatment difference. Dry matter cuts and plant tissue tests were taken on 18 August 2010. The plant tissue analysis showed no treatment difference. There were higher levels of dry matter measured on the spaded plots as compared to the unspaded control, with higher levels in the plots spaded in spring of 2009 plots compared to the autumn 2010 spaded sites (Figure 1).

Root DNA analysis from samples taken on 23 September also identified that plants in the spring 2009 spaded plots had greater root mass at 10-30 cm depth than the 2010 spaded plots that were also higher than the control (Table 2).

Table 1 Trial site details

Co-operator	Location	Trial Type	Crop	Measurements	Treatments
Houston	Ungarra	Replicated small plot	Correll wheat	Plant emergence, plant tissue analysis dry matter, root DNA, fungal biomass, yield	Non-spaded, spaded spring 2009, spaded autumn 2010
Young	Ungarra	Replicated small plot	Wonga lupins	Plant emergence, plant tissue analysis, dry matter	Delved 2008, delved 2008 and spaded autumn 2010
Young	Ungarra	Demonstration	Canola	Visual only	Spaded with vetch incorporated spring 2009
Snodgrass	Ungarra	Replicated small plot	Fleet barley	Plant emergence, plant tissue analysis, dry matter, yield	Clay spread 2008, clay spread 2008 and spaded autumn 2010
Treloar	Edillilie	Demonstration	Canola	Yield	Control, spaded 2009, spaded with lucerne straw 2009

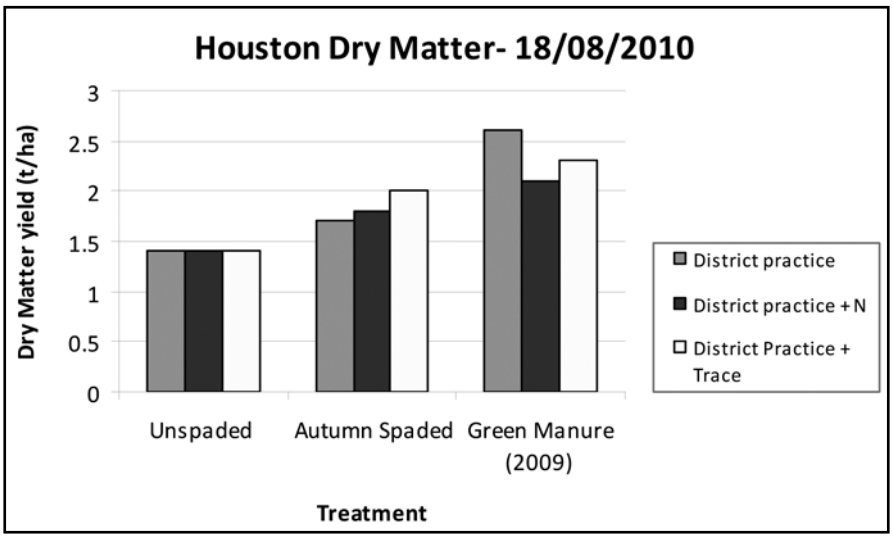

Figure 1 Dry matter cuts taken from Houston site in August 2010

Although these results showed differences in plant growth between treatments they did not translate to grain yield with no difference between the yields (Table 3). A gradual decline in yield was observed on plots in the southern portion of the trial and site variability may have been a factor.

Young Ungarra

The Young trial site was lupins on sand over clay delved in 2008 with half of the trial site spaded in 2010. Nutrition treatments applied across the site compared a Nil fertiliser control, P only (superphosphate at 113 kg/ha), District Practice (60 kg/ha of 18:20) and District Practice with trace elements (3 kg/ha Cu, 3 kg/ha Zn, 5 kg/ha Mn).

Plant emergence and dry matter cuts were taken on the site, but as the spaded portion of the trial was totally dominated by ryegrass harvest yields were not taken. This trial has raised issues about the timing of spading and subsequent weed management; these issues will be further explored in 2011.

The canola demonstration was also not harvested; however there was a significant visual difference with plants considerably taller and with more pods on the spaded area compared to unspaded areas. Spading has been conducted on an adjacent vetch paddock to allow replicated trials to be conducted in the 2011 season.

Snodgrass Ungarra

This site was on a sand over clay soil that had been clay spread with a high rate of clay (>250 t/ha) in 2008. Half of the trial site was also spaded in 2010. Nutrition treatments applied compared a District Practice (60 kg/ha 18:20) and District Practice with trace elements (3 kg/ha Cu, 3 kg/ha Zn, 5 kg/ha Mn).

Plant emergence counts taken in early July recorded 10% higher plant numbers on the unspaded treatments compared to the spaded treatments. Dry matter cuts and plant tissue tests were taken on 18 August 2010. Plant tissue analyses were similar between treatments. Dry matter results on both of the spaded treatments were over twice that of the unspaded treatments (Figure 2).

Table 2 Root DNA Samples taken from Houston site in September 2010

Treatment	Depth 0-10 cm (pgDNA A/g)	Depth 10-30 cm (pgDNA A/g)
Control	644	1001
Spaded spring 2009	508	2904
Spaded Autumn 2010	470	1819

Table 3 Houston wheat yields (t/ha), December 2010

Treatment	District Practice	District practice + Trace elements	District practice + N
Control	5.8	5.7	5.9
Autumn 2010 Spaded	6	5.9	5.9
Spring 2009 Spaded	5.7	5.8	5.7

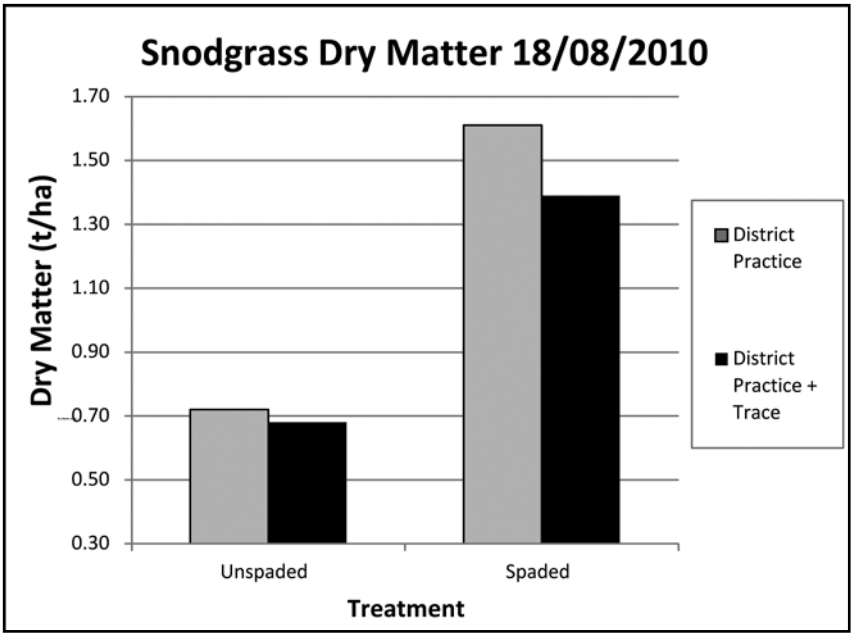

Figure 2 Dry matter cuts taken from Snodgrass site in August 2010

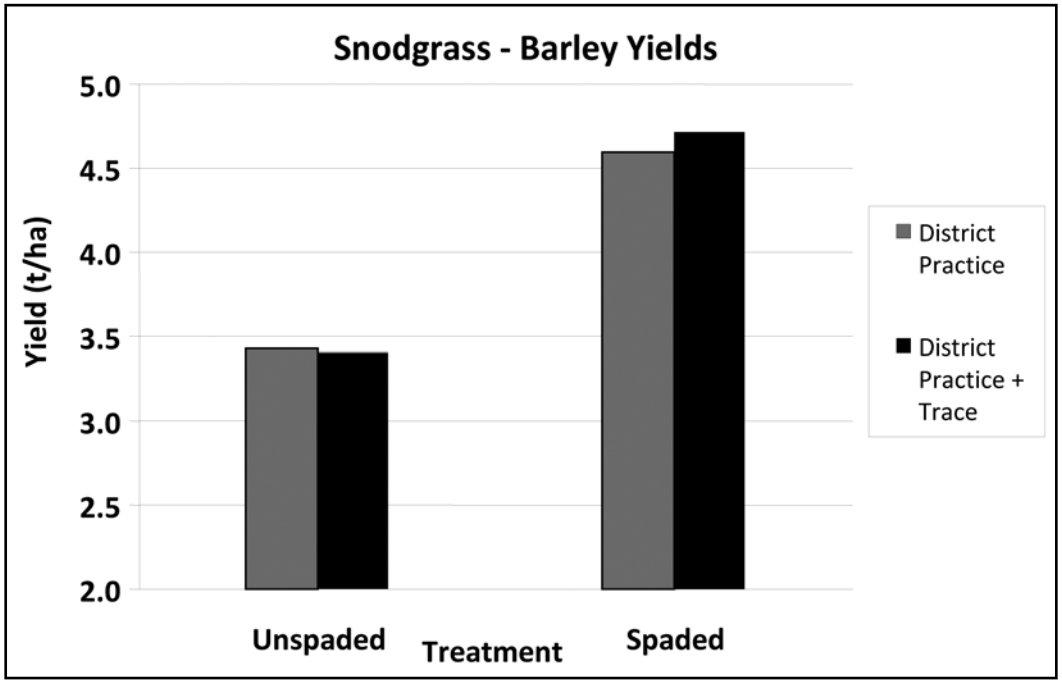

Figure 3 Grain yield from Snodgrass site, December 2010

These early differences in plant growth carried over to grain yield with the spaded plots yielding in excess of 1 t/ha (20%) higher yield than the unspaded treatments (Figure 3).

Treloar Edillilie

A significant increase in plant size and pod numbers was observed in canola on spaded plots with lucerne straw incorporated in early 2009. This followed a yield increase in lupins on these plots in 2009. The site had not been harvested at the time of writing.

What does this mean?

This series of trials and demonstrations are early scoping investigations designed to provide areas of interest requiring more detailed investigation. Issues to be researched in 2011 include:

- What form of organic material will provide the greatest dry matter and yield increases?
- What is driving these increases – nutrition, soil biology, soil water holding capacity or a combination?
- What are the changes to plant root mass and location following treatments?
- If cereal stubble is incorporated is there the need to provide additional nitrogen to reach suitable N:C ratios?
- How long are the potential gains going to last? Identification of organic carbon fractions may provide useful indicators.
- Will different soils respond better than others? For example soils with thicker bleached A2 horizons appear to provide greater response to incorporation of clay and organic material.
- How to best manage herbicide resistant weeds following spading.

This work will be conducted in conjunction with trials being developed on sand over clay soils in the South-East through the McKillop Farming Systems Group.

Acknowledgements

The authors would like to thank the landholders involved in this trial; John Houston (and Jason Durdin), Sam and Jim Snodgrass, Terry Young and Peter Treloar. They also extend their thanks to Terry Blacker, SARDI (Port Lincoln) for his efforts in sowing, maintaining and harvesting the sites.