American River In-tact Core Trial

Background

A field trial was run on the property of Simon and Sue Lovering in 2006 testing the performance of a range of subsoil amendments. There were some significant barley crop yield responses in 2006 to deep placed nutrients, deep ripping and deep ripping with PAMS respectively (See 2006 KI Ag Trials book).

This work was followed up in 2007 with a wide-ranging analysis of soil properties of soil samples taken from the site, and an in-tact core trial conducted in the glasshouse. The in-tact core trial measured the residual benefits of the 2006 treatments for Canola plant growth, and the effect of subsoil treatments on soil water quality.

What was done

Soil Properties

Early in 2007 we sampled this site to look at the crop water use limiting properties of the soil, and to evaluate if the subsoil treatments applied in 2006 had had an effect on soil properties. We measured a range of soil properties including: depth to clay, pH, salinity (EC), chloride concentration, exchangeable cations, sodium absorption ratio (SAR), extractable trace elements, Colwell extractable P and Nitrate-N.

In-tact Core Trial

In June 2007, we took in-tact cores to 50cm depth at the site of the 2006 Subsoils Trial on the property of Simon Lovering at American River.

Photo 1: Colin Rivers and Colin Bolto extracting 0.5 m deep in-tact soil cores.

We sampled from plots treated with deep-ripping only, deep-ripping with deep-fluid nutrients, deep-ripping with PAMS (a chemical amendment) and a control of no subsoil treatment applied. Back in the lab we inserted suction cups into the in-tact cores to sample water movement, and to monitor soil water quality during the experiment.

We then planted Beacon TT canola into each core. We watered the cores with artificial rainfall, where we assumed that 4 weeks growth in the field would take only 2.5 weeks in the glasshouse. However, the plants grew very quickly (higher temperatures and more daylight in the glasshouse between October and January than would occur in the field during winter), so we were forced to increase watering to prevent water stress and ensure that we could take water-quality samples. After 3 months of growth we harvested the plants.

Photo 2: The in-tact core trial in the glasshouse after only one month of growth.

Results

Soil Properties

The site is a sand-over-clay (duplex) soil.

We took a soil core from each plot and found that the depth to clay varied from 13.5 to 48 cm. However, depth to clay was not a significant factor influencing yield response to treatment as is sometimes the case in texture-contrast soils.

The sandy topsoil at this site has a poor ability to hold water and nutrients, while the clay layer below is able to hold water and nutrients, but is prone to waterlogging and salinity as it is in a low-lying area adjacent to swamps.

The soil properties of untreated samples (no subsoil amendment added) from the site are presented in Table 1.

Table 1: Soil properties of untreated soil

Horizon	**A1**	**A2**	**B1**
Approximate Depth (cm)	0-10	10-35	35+
$pH_{1:5}$ (H_2O)	5.3	6.3	8.5
$EC_{1:5}$ (dS/m)	0.77	0.05	2.92
Colwell extractable P (mg/kg)	32.3	6.8	1.0
1M KCl extractable Nitrate-N (mg/kg)	29.2	5.3	2.9
$Chloride_{1:5}$ (mg/kg)	52.7	13.7	96.6
DTPA extractable trace elements (mg/kg)			
Iron	173.0	132.7	16.6
Copper	0.4	0.2	0.03
Manganese	1.6	0.5	0.0
Zinc	1.8	0.8	0.2
Ammonium acetate extractable cations (mg/kg)			
Calcium	441.4	341.2	1146.8
Potassium	71.4	84.3	1459.1
Magnesium	81.7	64.3	1008.8
Sodium	90.8	84.0	1757.5
Sodium Absorption Ratio (mmol/L)	1.3	1.0	3.1

Some plots were found to be highly saline (EC 2.3-5.7 dS/m). However, removal of these hypersaline plots from our analysis of yield response to subsoil treatments did not influence the significance of the 2006 yield response to treatments. The hypersaline plots do not occur consistently in one or a number of treatments and have such a high EC relative to the other data that they skew the effect of subsoil treatment on EC. If the hypersaline plots are removed, there is not an effect of subsoil treatments on soil EC. There was not a significant effect of subsoil treatment on soil chloride concentrations, exchangeable cations, SAR, extractable trace elements, Colwell extractable P and Nitrate-N.

Table 2: Total Canola (Beacon TT) Dry Weight per core for each subsoil treatment after 3 months of growth. A different letter in the l.s.d. column means the treatment is significantly different from another treatment.

Treatment	**Total Canola Dry Weight (Beacon TT) (g/core)**	**l.s.d.**
Control	10.77	b
Deep rip	11.68	b
Deep rip + deep nutrients	15.51	a
Deep rip + deep PAMS	12.36	b

In-tact Core Trial

After 3 months of growth in the glasshouse, the highest-yielding, and only treatment significantly better than the control, was deep-ripping with nutrients.

The greatest amount of water was sampled in suction cups positioned in the A horizon and on the A-B horizon boundary treated with deep ripping only. The phosphorus, nitrate-N, EC and SAR in the suction cup samples were not significantly different for different subsoil treatments.

We are now analyzing the effects that the subsoil treatments had on macroporosity (big pores) and root growth. These factors will control the movement and use of water throughout the profile, particularly in wetter growing seasons.

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Take home message

- Deep ripping with deep nutrients was the most effective subsoil amendment in the field in 2006 and glasshouse in 2007
- Deep ripping increased the amount of soil water deeper in the profile, but subsoil treatments did not affect soil water quality properties in this soil