

20:20 Carbon Challenge: South-East Trial Report

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Agricultural Bureau
of South Australia Inc.
PATHWAY TO IMPROVEMENT



**Government
of South Australia**
Department of Environment,
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Australian Government
Department of Agriculture, Fisheries and Forestry
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RURAL SOLUTIONS SA

Roger Grocock Site

Initial carbon data was obtained from samples collected from 20 randomly selected locations in a 25m grid in February 2012.

Site sample depths were determined by soil horizons but were collected in 10cm increments to 30cm.

A minimum of 3 bulk density samples were collected (delved soils 3 bulk density measurements on and off the delve line). These identify the weight of soil in a given volume. This information is necessary to convert carbon % to carbon stock (t/ha).

Organic carbon was measured using the Walkley Black analysis. This method does not measure the mineral forms of carbon such as in lime, but also does not measure the organic carbon contained in charcoal forms that are usually between 20-25% of the total organic carbon. Percentage carbon levels were then converted into carbon stock using the relevant bulk density data obtained for each site.

Clay Content and Distribution (Figure 1)

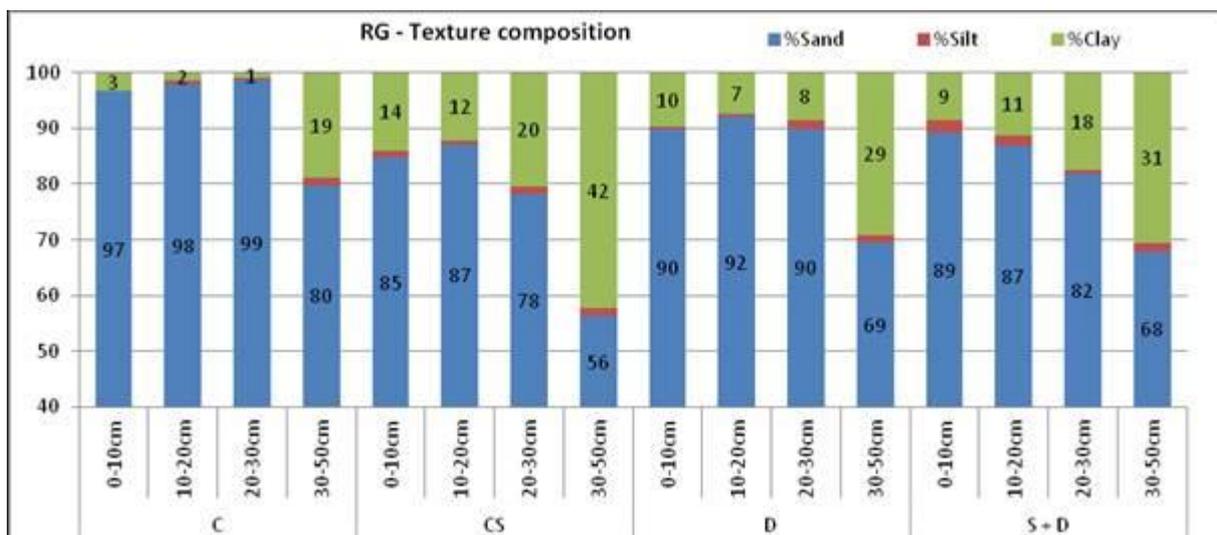
Control site: clay content is very low in the top 30 cms with a light clay (only 19% clay content) found between 30-50cm.

Clay spread site: had the greatest surface clay content with good incorporation of clay to 20cm. The subsoil clay of similar clay % to the control enters the profile between 20-30cm indicating the sample site was located on a relatively shallow sand over clay compared to many clay spread sites.

Delved site: had less clay raised through the profile compared to the CS site but did have higher levels than the control.

Spaded + delved site: has increasing levels of clay down the profile.

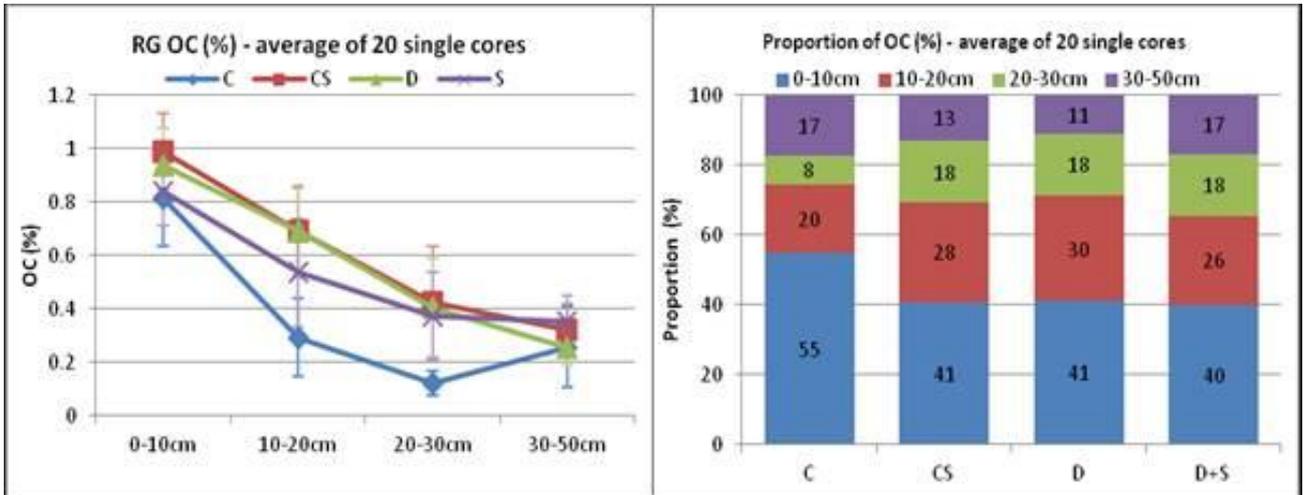
Figure 1: RG Particle size distribution



Organic Carbon %

SOC percentages were lowest in the control site compared to all the modified sites with clay spread and delved sites having the highest values, (Figure 2). Note that the biggest change in soil carbon % compared to the control occurs in the 10-20cms and 20-30cms depths. This suggests that the bleached horizon has been ameliorated through clay modification. The spaded site did not evidence the same level of change in carbon % as the clay spread or delved sites. This may be due to the relatively recent degree of disturbance resulting in greater mineralisation of organic carbon in this treatment.

Figure 2: RG average and proportional OC (%)

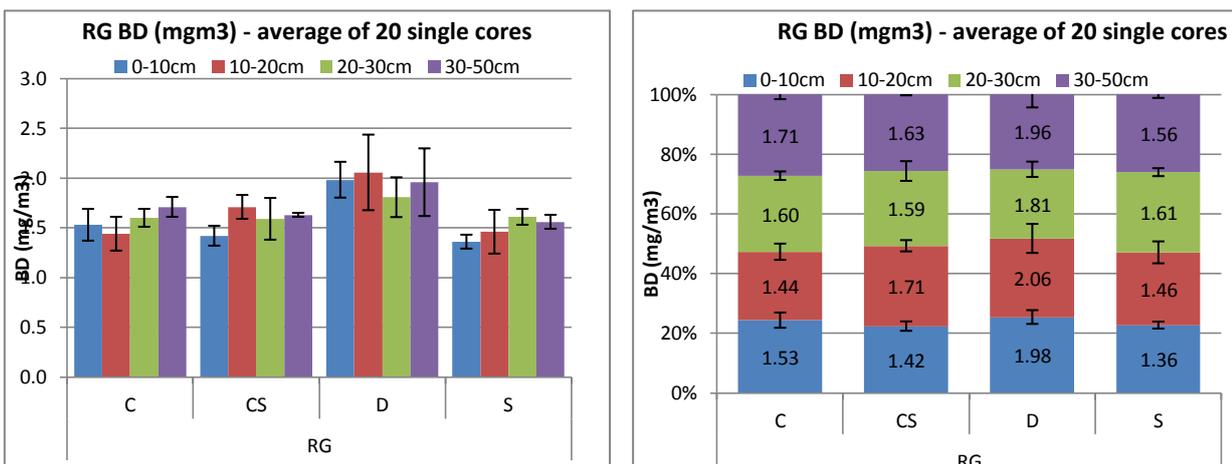


Bulk Density

Bulk density is the measure of soil weight per given volume of soil. It is measured using a core of known volume with the sample dried and weighed with weights expressed as megagrams/cubic metre (also equivalent to grams/cubic centimetre). Values of 1.3-1.6 are considered to be appropriate.

Bulk density values obtained in the original sites are similar between although the lower values in the CS and S sites may reflect greater level of disturbance incurred during the modification process. The D site has the greatest BD values however, sampling of delve lines is more difficult as the mixture of clay clods and sand compromises sample integrity. The delved results need validation as they appear high compared to other delved sites.

Figure 3: RG bulk density

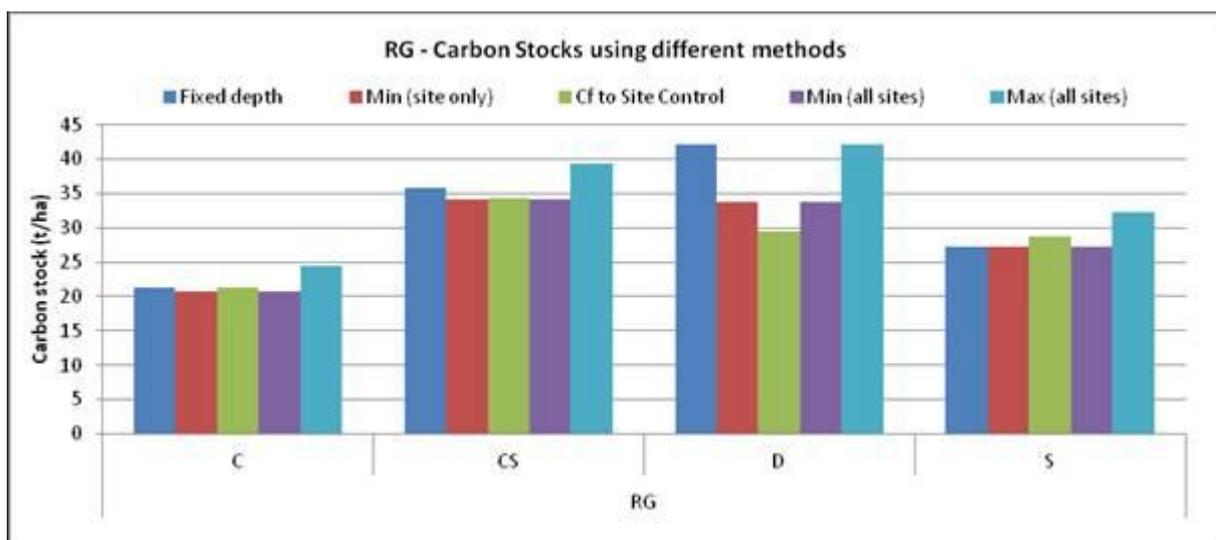


Carbon Stocks

Carbon stocks are determined by multiplication of the % carbon by the bulk density value. C stocks reflect SOC % trends with control stocks only just over half of the C stocks of clay spread and delved sites (~21 t/ha compared to 35t/ha). The spaded site has only 7t/ha C stock higher than the control but is below the delved and clayed sites. With the higher clay content of the soil it would be expected to have higher C stocks but this may reflect the relatively recent disturbance with less time to build carbon stocks up to the new carbon holding potential.

The results are highly promising as the increases in carbon stock in the clay spread and delved sites equates to almost 20t/ha (CO₂ equivalents).

Figure 4: RG Carbon Stocks



This work demonstrates that significant increases to soil organic carbon can occur following the addition of clay to sandy soils. The increases in soil carbon are likely to be as a result of 2 processes being:

- 1 Increased protection from biological attack afforded by the clay to organic matter
- 2 Increase in biomass produced

The latter has been commonly observed following claying and is the result of addressing issues such as non-wetting, poor fertility and low water holding capacity. However, increases in above ground biomass are unlikely to have a significant impact on carbon values in subsoil horizons. Studies conducted elsewhere have suggested that increasing clay content of the bleached A2 horizons will result in greater levels of root biomass, These studies have also shown that the addition of organic material to these layers further increases both root biomass and above ground production. These results are being further explored on this and other sites in 2012.

2012 Trials

To identify if sites have reached the maximum productive capacity following modification 4 sites were established on the properties of Roger Groocock and Steve Jaeschke Sites were located on both clayed and delved areas and were established in late May and sown in June.

Treatments

- Control (clay modified)
- Clay modified + spading
- Clay modified + spading + lucerne straw (approx. 10t/ha)

Roger Groocok

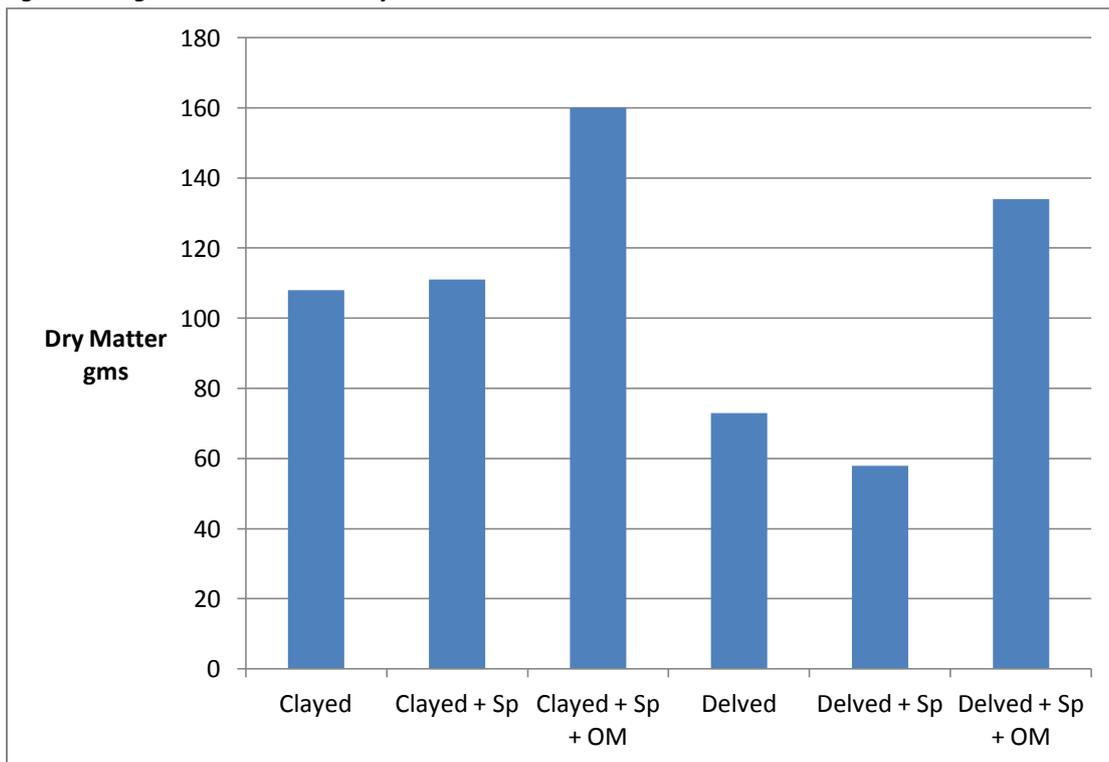
Crop: Wheat

Measurements: Dry Matter cuts, Yield.

Results -Dry Matter cuts, September 2012

The delved site in a low lying area of the paddock and was subject to waterlogging and delivered lower levels of dry matter than the clayed site. There is limited difference in dry matter between the spaded and control treatments. There is a major response to the addition of lucerne straw on both sites.

Figure 5: Roger Groocock Trials Dry Matter cuts



These results are extremely interesting but difficult to explain. The greater growth generated by the addition of lucerne straw appears to have used more water resulting in less waterlogging. However, this cannot be confirmed without detailed soil moisture measurements conducted during the season. The increased growth

observed on both sites through the addition of lucerne straw may be a nutritional response. However, the landholder reports that water logging occurred quite quickly following seeding and therefore a greater level of plant growth must have occurred from early in the growth cycle. If this is the case it is questionable that the plant nutrient requirement at this stage would have exceeded the fertiliser input provided at sowing. Also was there sufficient time for the lucerne straw to breakdown to provide the additional nutrition? Further work is required to resolve these questions.

Steve Jaeschke

Crop: Barley

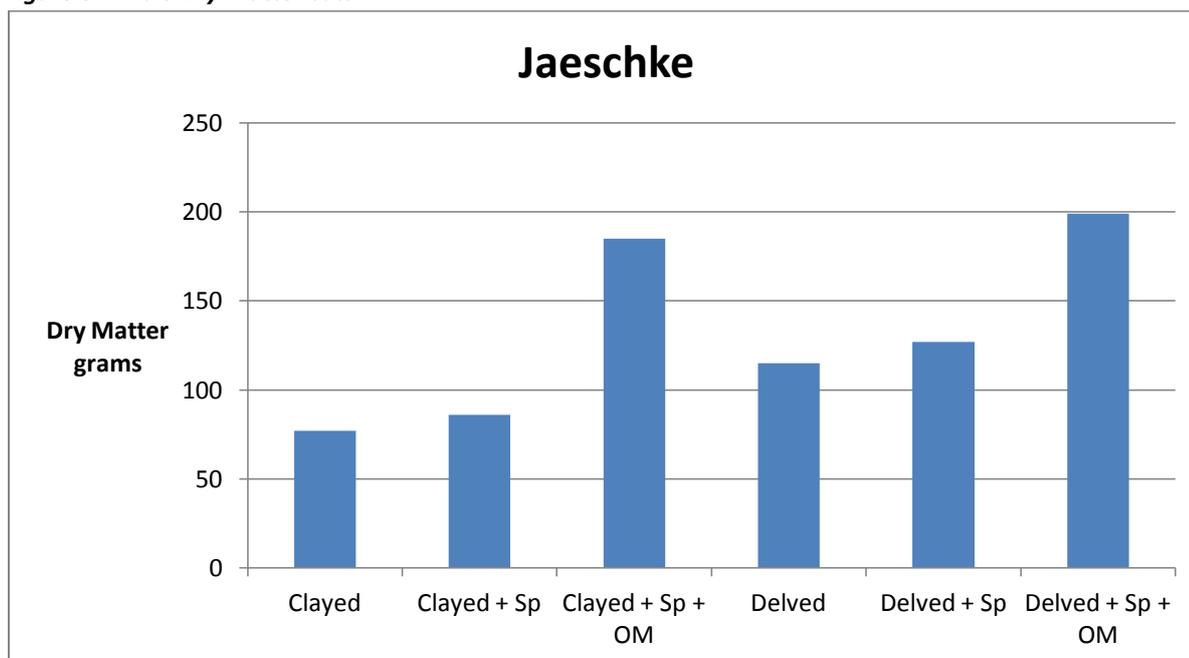
Measurements: Dry Matter cuts, Yield.

The delved site is located on the flat area of the paddock with the clayed site located on a low dune in the same paddock. Samples were taken in late May for organic carbon analysis but results have not been obtained at the time of writing. Clay levels on both sites are quite high with good incorporation to at least 20cms.

Results -Dry Matter cuts, September 2012

Similar to the Goocock sites there is limited difference in dry matter between the spaded and control treatments on both trial sites. However, there is a major response to the addition of lucerne straw on both sites.

Figure 6: Trials Dry Matter cuts

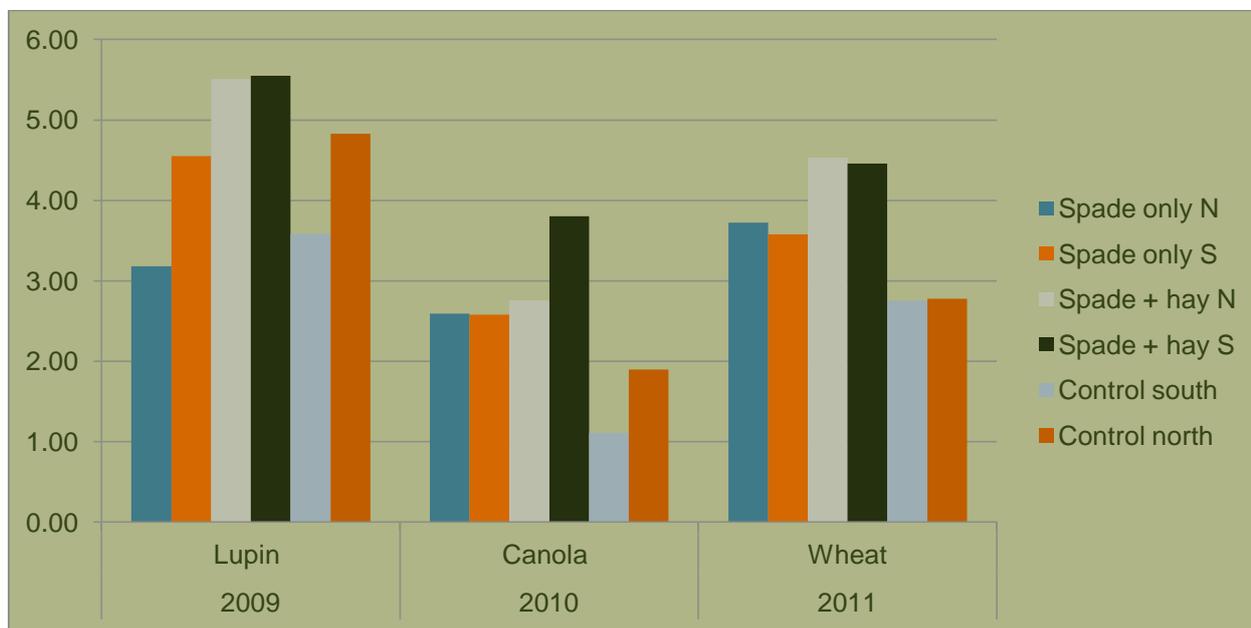


Again these results are very interesting and raise further questions regarding what is driving the response. These trials were sown on a bean stubble from 2011 and nitrogen measurements taken on the flat indicate high levels of residual soil N. This suggests that nitrogen may not be a significant factor.

Eyre Peninsula

Trials that have previously been conducted on EP have been extended with a number of demonstrations that have been established on new clayed sites or sites that have been clayed in previous years. The longest trial is on the property of Peter Treloar at Edillilie. Previous yield results are given in Figure 7.

Figure 7: Peter Treloar Trial Results 09-11



Dry matter cuts have also been taken at this site and other new sites this year. Results are tabled in Figure 8.

Figure 8: Dry Matter cuts (grams) EP clay demonstrations 2012

	Control	Control + sp	Control + sp + OM	Clayed	Clayed + sp	Clayed +sp + OM
Skinner	n/a	n/a	n/a	n/a	228	319
Treloar	126	n/a	n/a	n/a	173	217
Glover	99	n/a	n/a	n/a	132	361
Modra heavy	451	660	774	449	632	819
Modra light	n/a	n/a	n/a	549	634	597

The results at the Modra sites are interesting as there has been a response to incorporation of organic matter (Lupins @ 10t/ha) even where the site has not been clayed however, the addition of OM to the light clayed site has not seen an increase in dry matter production. The Glover site is in the second year and similar to last year there are higher levels of dry matter on the clay added + spaded and a further increase in clayed = spaded = organic matter (canola straw @ 10t/ha).

Take Home Messages

The addition of organic matter with incorporation to 30cms appears to offer significant increases in production however, results are highly variable. This work needs to be extended further to try to determine what is driving these changes, how long benefits last and what the economics are in doing this work.