20:20 Carbon Challenge: Young, Groocock Site Reports

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Detailed comparison – RG and TY

To provide more detailed understanding of changes to carbon and other soil parameters following different soil modification techniques and to improve the validity of sampling methodology; detailed analysis was conducted on two selected properties. The greatest area of soil modification has occurred in the South East and on the Eyre Peninsula and a property from each region was selected: Roger Groocock, (Wirrega) and Terry Young (Ungarra). Selection attempted to minimise external factors that may influence SOC concentrations (rainfall, management) and where a number of different modification techniques (clay spread, delving and spading) could be compared to a unmodified (control) site.

Soil cores for depths to 50cm were collected from 20 randomly selected locations in a 25m grid in December 2011 (TY) and February 2012 (RG). To minimise error in SOC values that was observed in earlier sampling (generally when the clay horizon was included into the sandier mixed topsoil horizons) samples were taken within soil horizon boundaries.

The TY site sample depths were determined by soil horizons, resulting in the control, clay spread and delved site having a layer equivalent to 10-30cm (there was no soil horizon change in the bleached A2 at this depth). The spaded site had no discernable horizon changes due to the greater level of mixing and was sampled in 10cm depth increments (see Table 1).

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

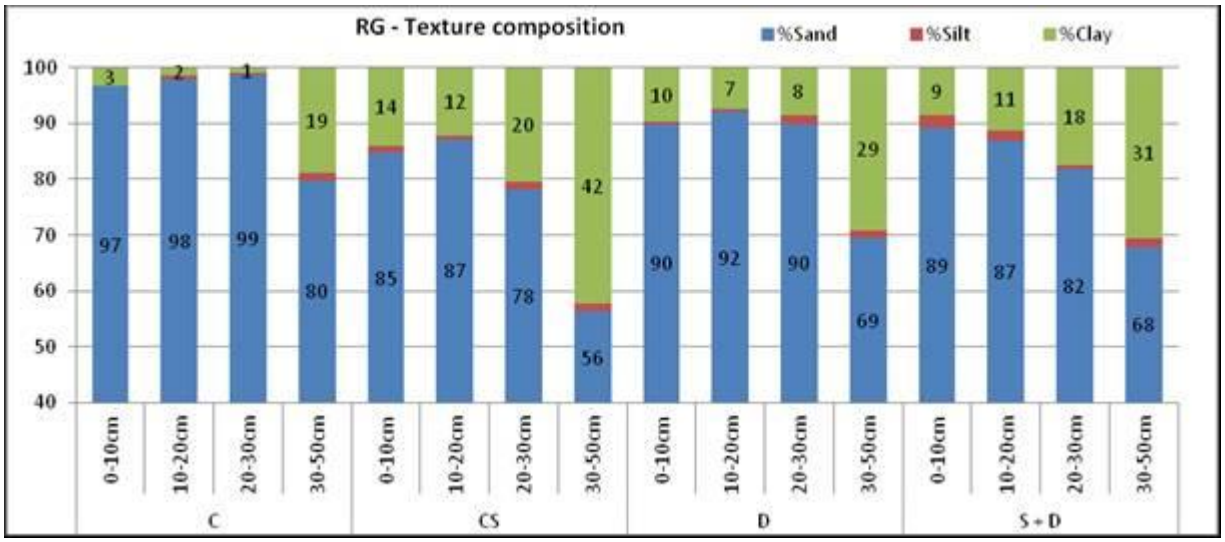
A minimum of 3 bulk density samples were collected (delved soils 3 bulk density measurements on and off the delve line). These identify the weight of soil in a given volume. This information is necessary to convert carbon % to carbon stock (t/ha).

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.

Roger Groocock 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 in a shallow part of the block than is normally expected at a CS site.
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.
Silt contents are relatively low in the treatments.

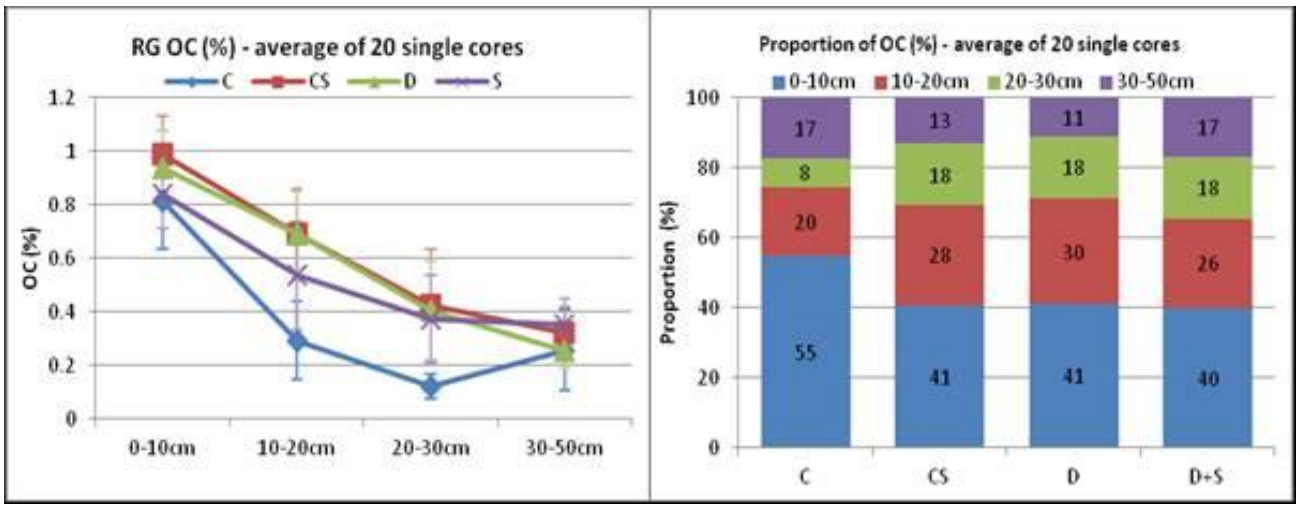
Figure 1: RG Particle size distribution



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 suggest 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.

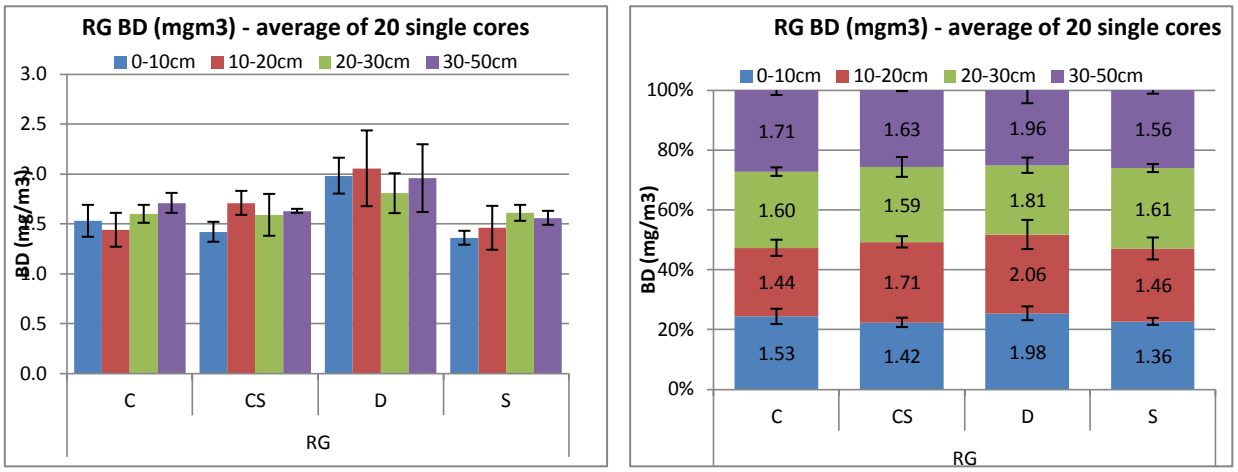
Figure 2: RG average and proportional OC (%)



Bulk Density

Bulk density values are similar between C, CS and S soils 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

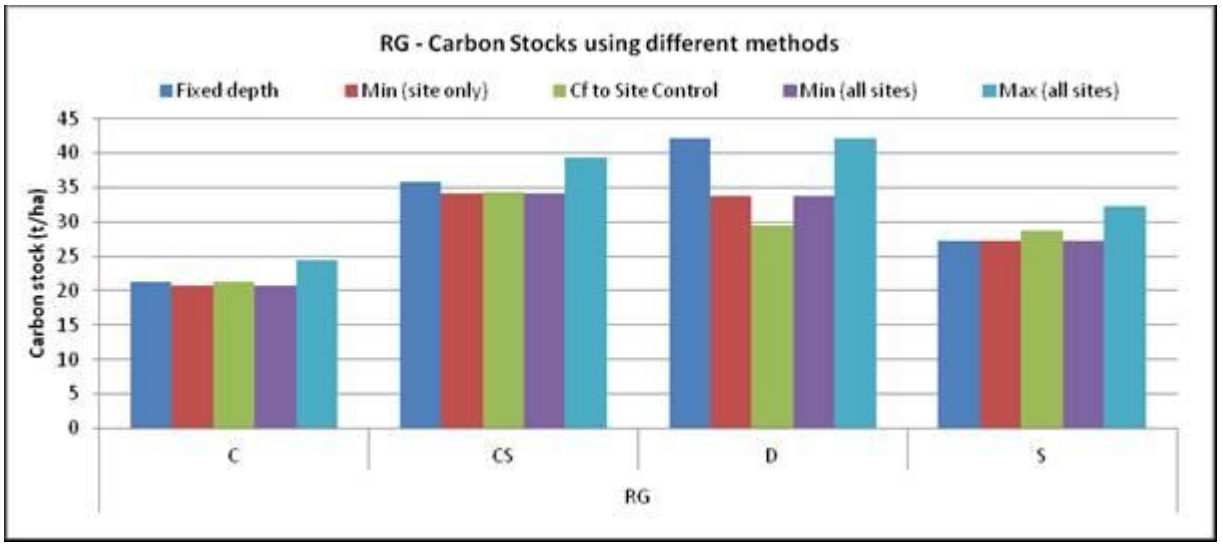


Carbon Stocks

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

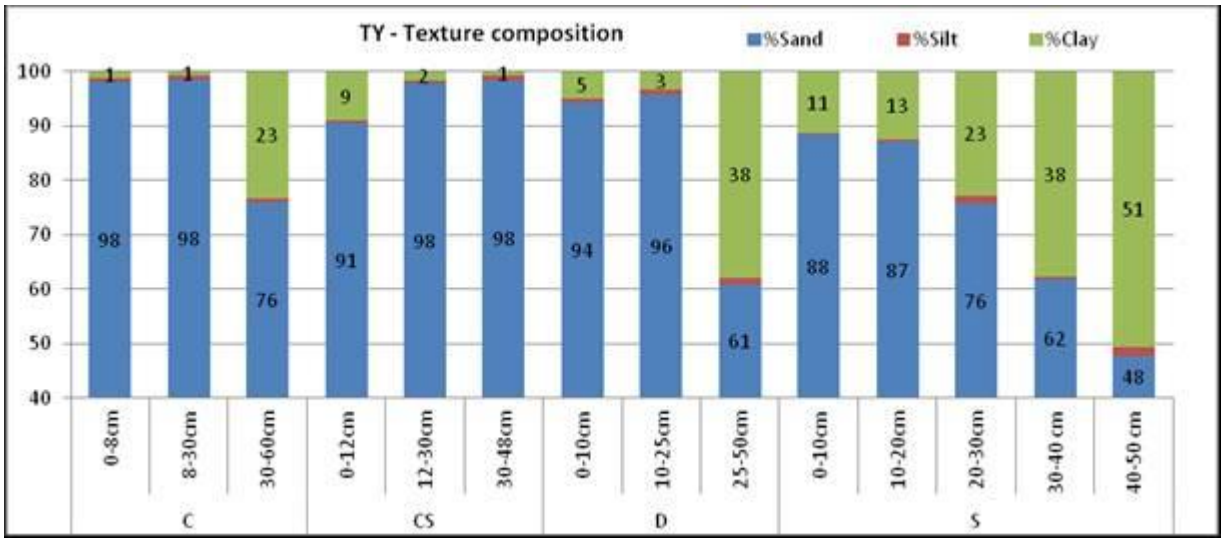


Terry Young Site

Clay Content and Distribution (Figure 1)

The clay content is very low in the control site to 30cms with the subsoil clay horizon located at 30-60cm at around 23% clay content. The clay spread site is located on a deep sand and has clay levels of around 9% in the 0-10cm layer. However, visual observation suggested that even within this layer most of the clay was located near the surface. This suggests that shallow incorporation has occurred that is supported by the data that suggests that little or no clay has been incorporated below 10cms. In this case the bleached horizon has not been addressed. The delved site has low levels of clay in the 0-10cms and 20-30cms layers with subsoil clay locate at 25-50cm. This indicates that the delving operation has only raised low levels of clay and further research is required to determine why this has occurred. The spaded site has good levels of clay in the 0-20cm depth with subsoil clay found between 30-40 cms. The higher levels of clay found in this site reflect the greater capacity of spading to raise clay where it is found within reach of a spader and possibly the higher clay % of this material compared to the subsoils of the other sites.

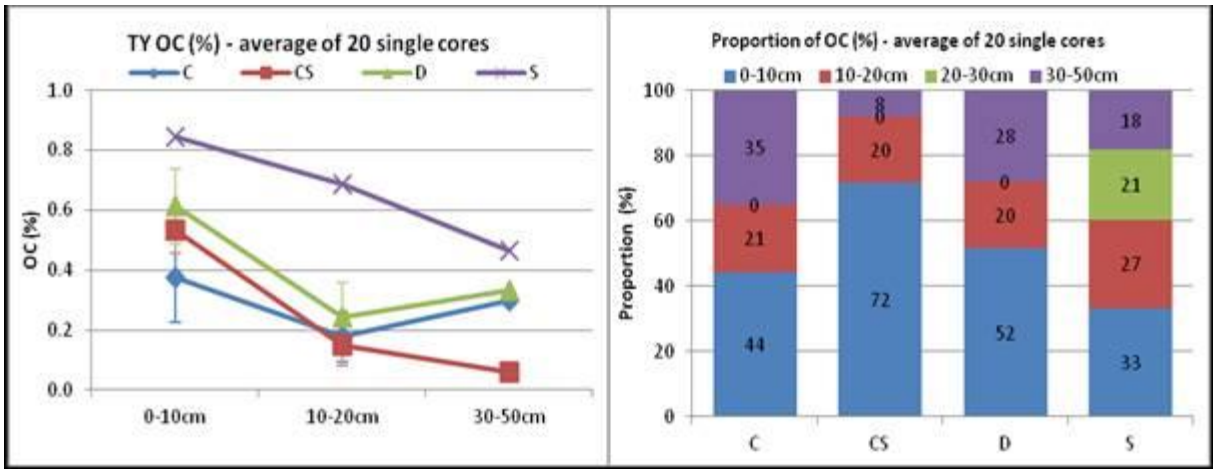
Figure 5: TY Particle size distribution



Organic Carbon %

Organic carbon % in the 0-10cm layer is higher in all modified treatments compared to the control with the spaded treatment significantly higher than the other modification treatments. Below this depth the only treatment with higher levels is the spaded treatment that has very high carbon values compared to the control and other modification treatments. This accords with the clay data where spading is the only treatment that has realised a major change in clay levels in the 10-40cm layer. It is also of interest that carbon values in the spaded treatment are relatively evenly distributed throughout the depth of modification. Further work is required to confirm the reason for this but may result from the incorporation of organic material deep into the profile during the spading process.

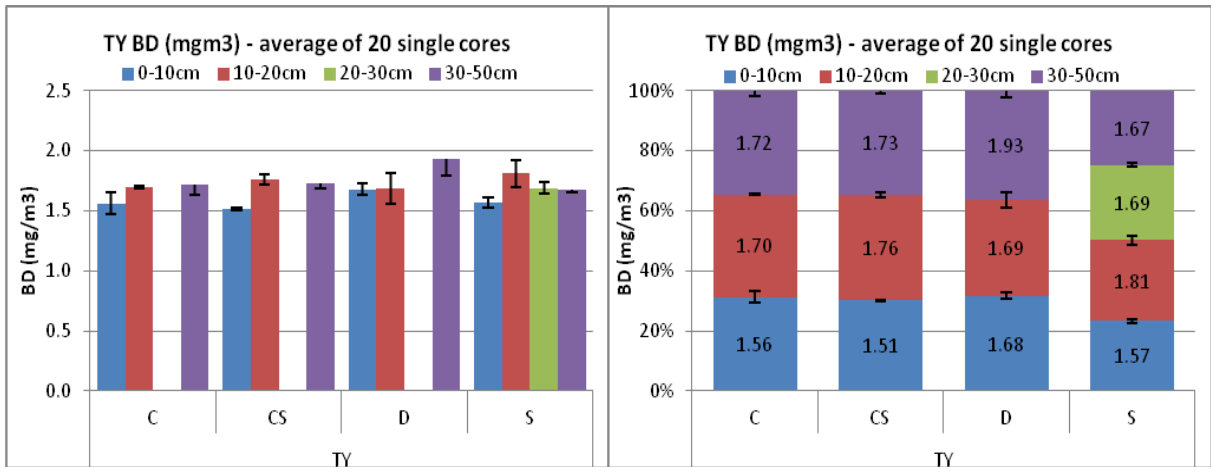
Figure 6: TY average and proportional OC (%)



Bulk Density

Bulk density values are similar across all sites with little variation. Topsoil values are slightly high with the spaded site having the lowest value. This may be due to the more recent disturbance but may also result from the higher levels of organic carbon found in this layer compared to the other sites. BD levels in the subsoil of all sites are considered high reflecting the poor structure evident when sampling

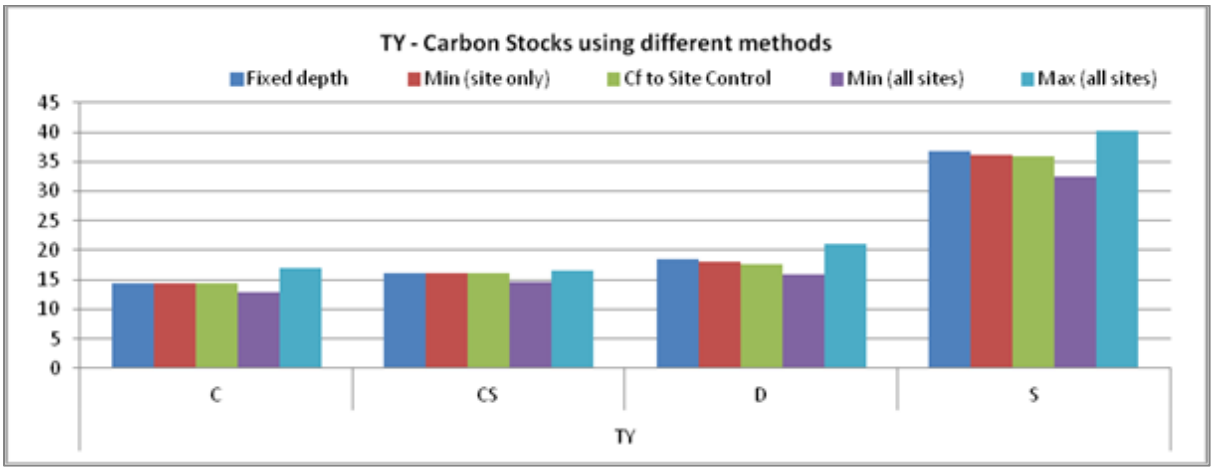
Figure 7: TY average and proportional bulk density



Carbon Stocks

C stocks are highest in the spaded site (35 t/ha) with over double the stock compared to the control (15t/ha) and higher than other modified sites (16-18t/ha). While the higher carbon stocks do accord with higher clay levels found in the spaded site this is a large change over a relatively short time frame. The possibility of incorporation of organic matter in the spading operation needs to be further investigated. It would be useful to undertake MIR analysis to determine the status of different organic carbon fractions ("new" vs "old" organic carbon) on this site.

Figure 8: TY Carbon Stock (t/ha).



Summary

While there is still some work to be undertaken there are some clear changes resulting from soil modification on these sites including:

- Decreased bulk density (soil mass) when compared to unmodified soils. This could be expected to be a result of physical disturbance and possibly the influence of higher organic carbon levels that has a role in maintaining soil structure. High bulk density in delved lines at the Groocock site need some further investigation. These results may be due to the difficulty of sampling due to large clay clods in the delve line. If bulk density has been exaggerated carbon stocks will also be higher than actual.
- There is a significant shift (increase) in carbon in deeper layers, particularly the 10-20cm layer (old bleached A2 horizon).
- Higher levels of carbon stock in modified sites compared to unmodified soils.
- There is no one clay modification method that appears to consistently increase SOC stocks. At the RG site the clay spread and delved sites had greatest C stocks whilst at the TY site the spaded site had greatest C stocks. This result needs further investigation and in particular the difference in prespading surface cover needs to be considered.