Storing soil carbon

on northern wheatbelt sandplain

What

Soil organic carbon is central to soil functions such as nutrient cycling and soil structure. It is derived from the breakdown of organic matter such as stubble and roots. More recently the interest around soil organic carbon has been related to the price on carbon, carbon credits and the Carbon Farming Initiative. This factsheet will explain how much carbon we can expect to store in WA's dryland grain farming system.

Key Points

- Changing soil organic carbon on sandplain soil can be slow and requires large quantities of organic inputs.
- Trial results indicate that adding 60t/ha of chaff changed organic carbon by 0.5% over 9 years.
- Soil organic carbon must be measured as t/ha rather then % if being used for carbon trading.

Can we influence soil carbon?

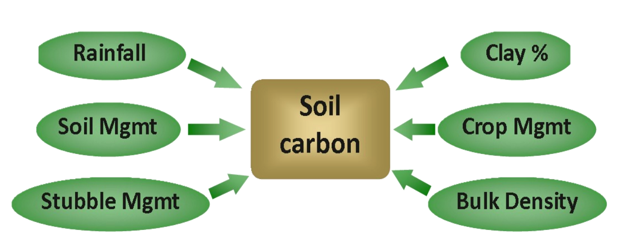
Short answer – Yes. Day to day management practices influence the amount of carbon entering or leaving the soil. This includes factors like crop types, stubble management & pastures. Baling straw or removing stubbles may result in a decrease in soil organic carbon levels whereas stubble retention can contribute to a positive change in soil organic carbon levels.

Measuring soil carbon – do I use % or t/ha

Most basic soil tests already measure carbon percentage (%). National accounting of soil organic carbon (for trading) requires values to be presented on a "per area" basis (i.e. t/ha). Once it is converted to t/ha is called soil carbon "stock". To turn a carbon % into carbon stock (t/ha) a measure of soil bulk density (BD) is needed.

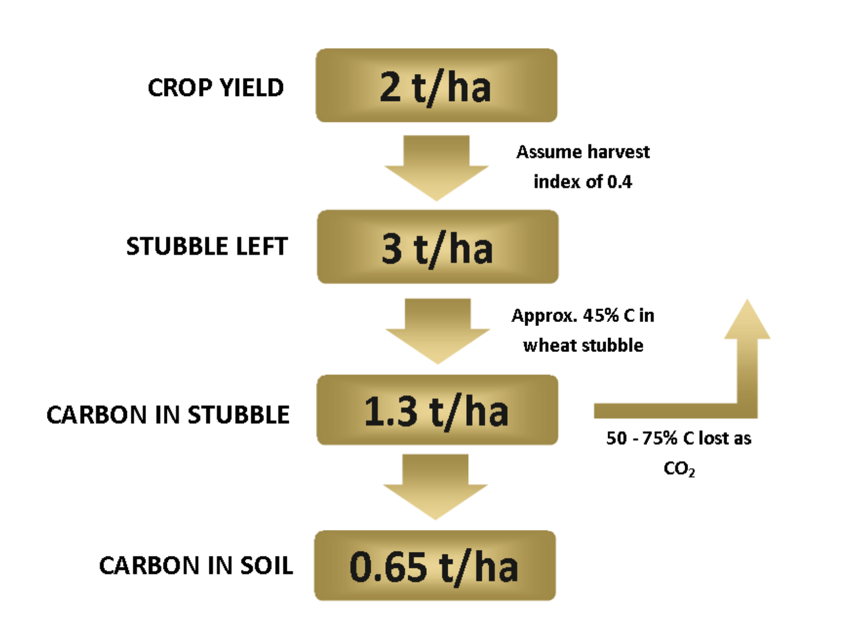
Storage potential depends on soil type and rainfall

In the WA grain farming systems the difficult task is achieving a measurable change, while minimising major alterations to current farm practices.



Some predictions – how much crop do I need?

Not every molecule of carbon left behind in stubbles or pastures will turn into soil organic carbon, there are many competing factors. The figure below shows you what to expect to retain from a 2 t/ha crop.



Above: Flow diagram illustrating expected quantity of carbon which potentially could be stored from a 2t/ha wheat crop.

Clay- Compared to a global scale WA soil is sandier than most. Sandy soils by nature have a very low clay content which reduces the soils ability to store carbon. The relationship between clay and soil organic matter is important, as clay particles bind to organic matter (helping to form aggregates) and physically protect the organic matter from predation by soil fauna. In most W.A. soils this doesn't occur as clay percentages are too low.

Rainfall- WA's relative low rainfall reduced the amount of plant biomass that can be grown. Less plant biomass means less potential carbon available to enter the soil.

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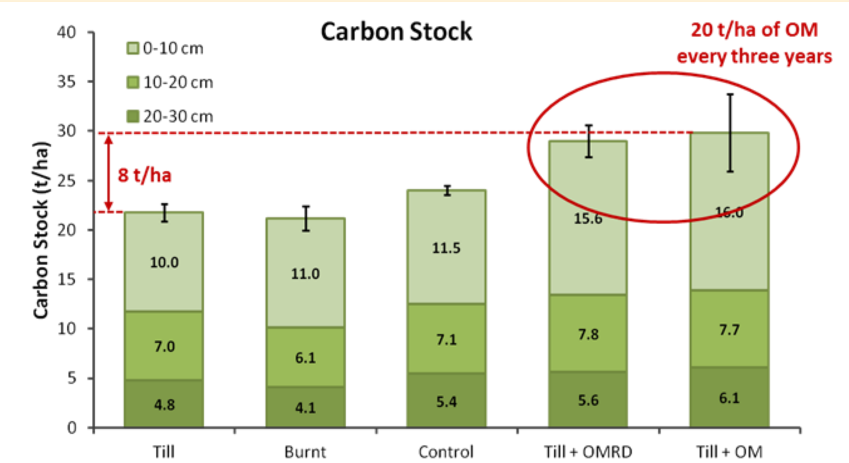
Liebe trial results – A lot of chaff for small reward

A large scale trial was set up in 2003 to test the upper limits of soil organic carbon storage for sand plain soils in the low rainfall W.A. wheat-belt. The trial compares conventional minimum-till farming to external additions of chaff equating to 60 t/ha over 9 years. This massive addition of organic matter has resulted in only a small increase in carbon percentage of 0.5%. When converted to carbon stock (0-30 cm), this change equates to 8 t/ha – only 27% of the total amount added. Much of this chaff is still breaking down, so further increases will occur, but this highlights the limitations to increasing soil organic carbon by large amounts on sand soils.



Above: Carbon stock (t/ha) at the Liebe Group's soil biology trial where organic matter was added compared with tillage, burning, minimum tillage (control). Sampled 2011. Plots where chaff was added needed to be tilled in order to incorporate to stop chaff blowing away. Till + OMRD stands for tillage organic matter run down. 40 t/ha chaff added in 2003 and 2006, no further chaff has been added so organic carbon is being run down.

The key message for farmers from this trial

Changing soil carbon is difficult and slow. For a 0.5% increase in soil organic carbon a total of 60 t/ha of chaff was applied over 9 years. Of the 60 t/ha of chaff applied an extra 8 t/ha of soil organic carbon was stored in the soil. By comparison a 2 t/ha wheat crop could potential retain 0.65 t/ha of organic carbon to the soil. Logistically and economically adding 60 t/ha of chaff to a broad-acre paddock is not feasible with current technology.

Treatment	Nitrate (mg/kg)	P (mg/kg)	K (mg/kg)	Organic carbon (%)
Control	22.7 *ab*	30 *a*	74 *a*	0.77 *a*
Burnt	24.3 *ab*	32 *a*	96 *a*	0.78 *a*
Tilled soil	18.7 *a*	27 *a*	94 *a*	0.91 *ab*
Till+ OM	30 *b*	58 *b*	280 *c*	1.41 *c*
LSD	*8.17*	*11.5*	*27*	*0.34*

Above: Soil analysis for 0-10cm of soil at Liebe Groups trial site, Buntine. Sampled May 2012, prior to seeding. Note Treatments with the same letter next to them are not significantly different from each other.

Above: Nadine Hollamby & Chris O'Callaghan of the Liebe Group & Louise Fisk of UWA examining the deep yellow sand at Buntine WA where this trial was conducted.

Above: A total of 60 t/ha of oaten chaff was applied to the trial site, 20 t/ha at a time over three years. This quantity of organic matter is an uneconomical addition in our current farming system.

More nutrients

While the gain in soil carbon % from adding all the chaff has been small in percentage terms, other gains have included increased yield as well as increased soil nitrogen, potassium and phosphorus.

More information

www.soilquality.org.au
www.liebegroup.org.au

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