NSW GOVERNMENT Department of Primary Industries

Strategies to build soil organic carbon in cropping systems

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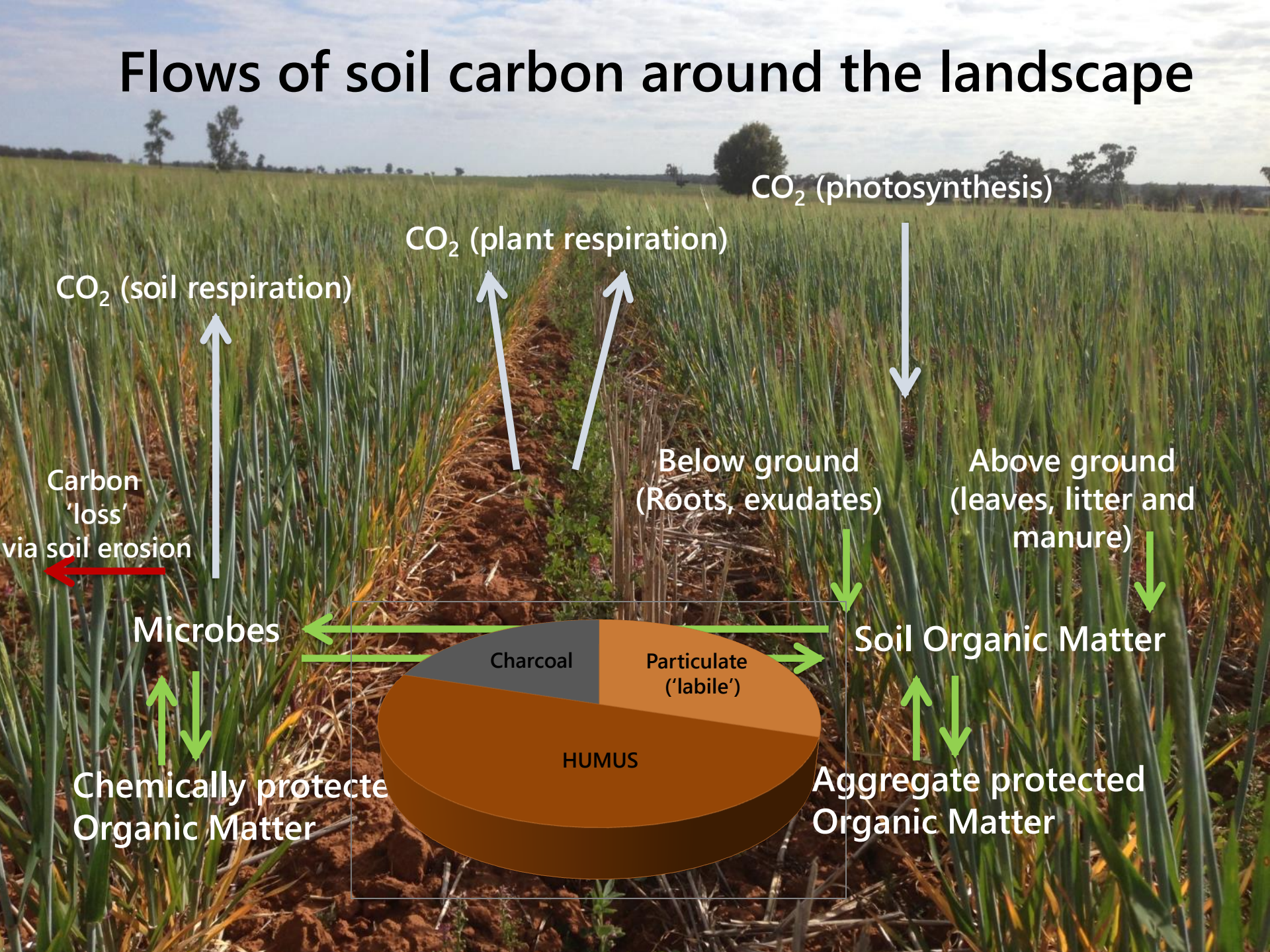
Flows of soil carbon around the landscape



Soil Organic Matter (OM) and Soil Organic Carbon (OC)

Soil Organic Matter

- <2mm partially decomposed organic residues
- microbes
- humus
- charcoal

Carbon is what we *measure;* soil organic matter is approx 58% C

The rest is…

O (10 to ~40%)

H (~5%)

N (8 to 10%)

P (0.5 to 2%)

S (1 to 1.5%)

and a range of nutrients and trace elements…

Soil Organic Matter (OM) and Soil Organic Carbon (OC)

- SOC% = total organic carbon in soil, g of C per 100 g soil

- Soil C stocks = t C/ha generally to 0-30cm

- CO_2-e 1 t of C = 3.66 t CO_2

(Carbon dioxide equivalent)

Why are we interested in soil carbon?

Production benefits

- Nutrient cycling
- Water infiltration and storage
- Plant growth & quality

Soil organisms – ‘functional carbon’!

Soils vary in their capacity to sequester and 'protect' carbon

SOC % is dependant on:

<u>Carbon (OM) supply</u>

Biomass grown or (carbon) amendment added e.g. compost

AND

<u>Carbon loss</u>

Decomposition and erosion

This is modified by the…

- Type of OM
- Soils capacity to store SOC

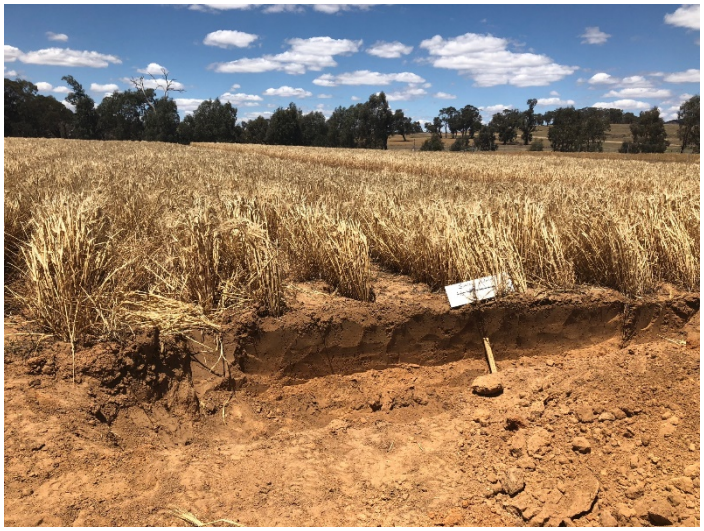
(clay%, mineralogy, depth, structure)

Soil, vegetation and climate factors influence carbon sequestration

- These factors drive productivity
- Some *<u>can</u>* be changed (plant type, structure)
- Some *<u>cannot</u>* be changed (clay, soil depth)

Management factors	C seq rate (t C/ha/yr 0-30cm)	Years	Reference

In some systems, why doesn't SOC increase despite 'best' management?



- Soil type and climate; major drivers of net primary productivity and decomposition
- Poor plant nutrition
- Water limited
- Background SOC levels
- Spatial variability

In some cases, perhaps SOC is not the best metric to compare the benefits of management…

Building soil organic carbon is important for soil structure

History of rice growth 'Natural'

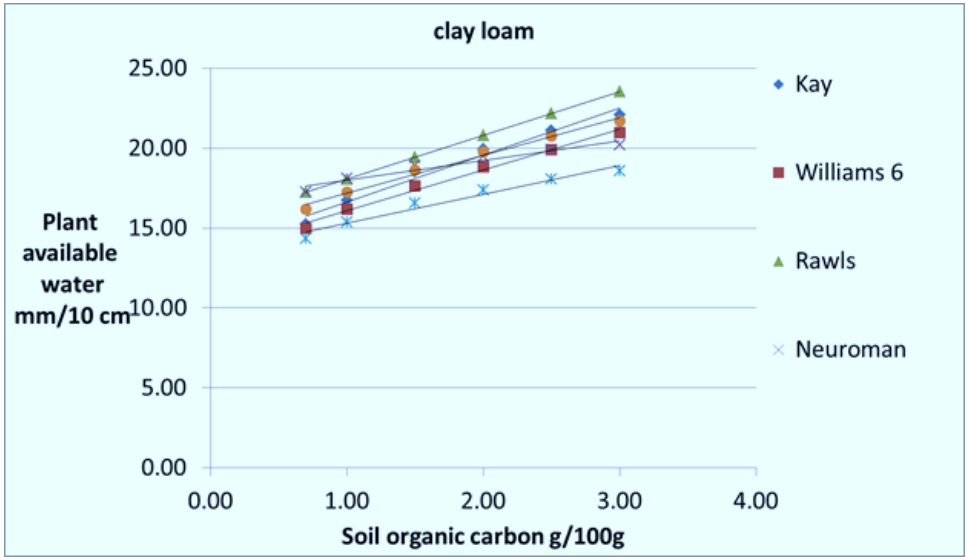
Plant growth; rotations, nutrition, stubble management

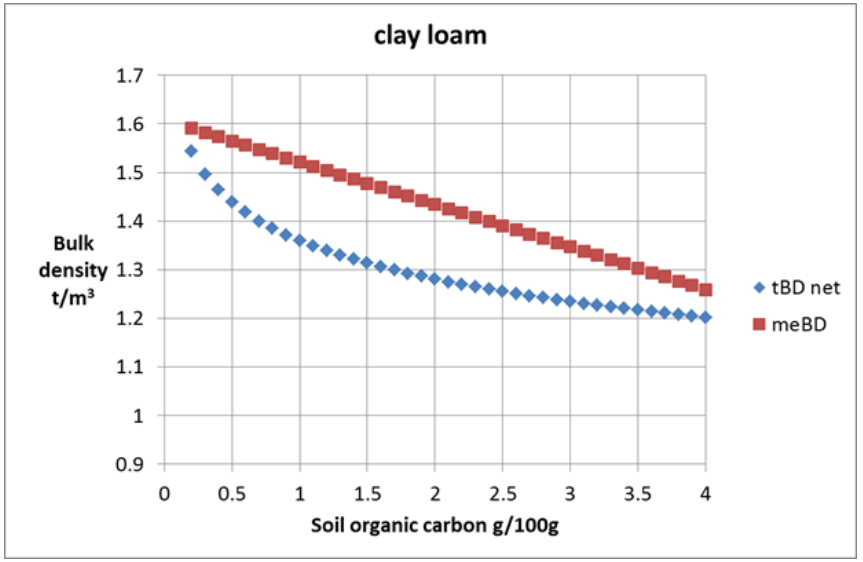
- Roots can form macropores
- Provides organic material to form aggregates
- Provides food for microorganisms to stabilise and build structure

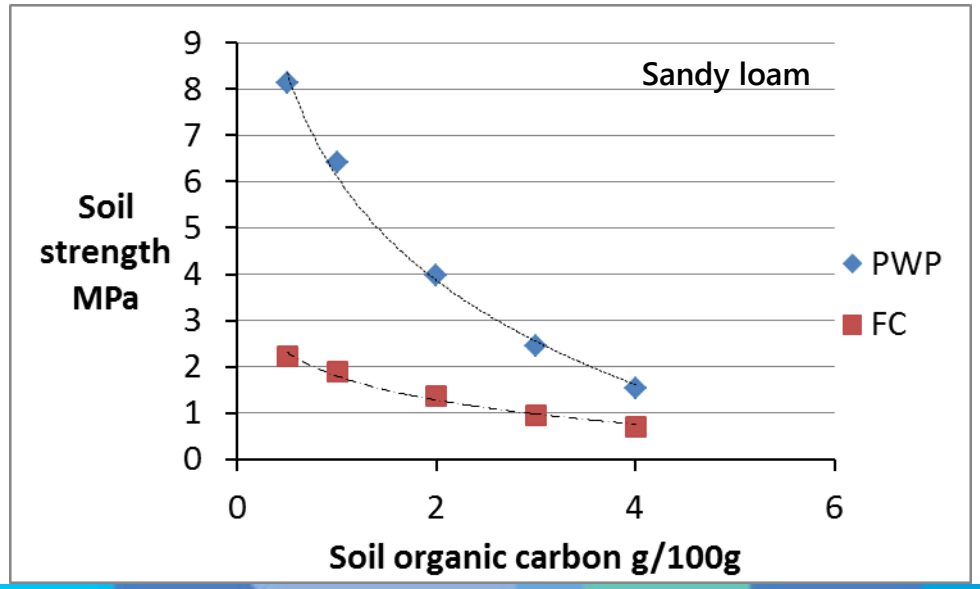
Is 2% SOC (0-10cm) the magic number?

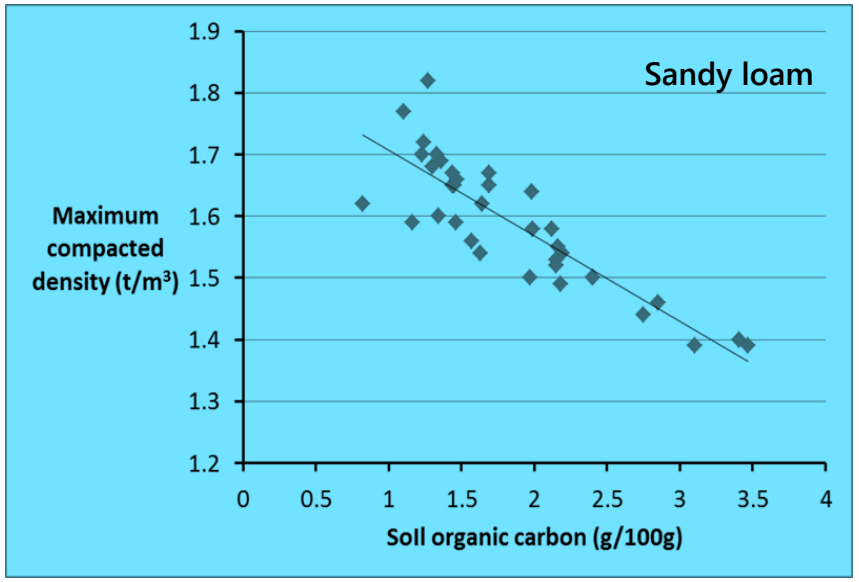
It depends…

Soil organic carbon and soil properties









Courtesy of Dr B Murphy

There are multiple strategies to build SOC

- Changing the crop and pasture sequence
- Introducing cover crops (?)
- Managing nutrient inputs to optimise plant growth and/or the decomposition of crop residues into more stable forms of SOC (humus)
- Applying lime to overcome acidic soil constraints
- Applying gypsum to overcome sodicity, compaction or surface sealing
- Minimising tillage, and in some cases considering strategic tillage (to overcome a soil constraint or plant disease)
- Retaining stubble
- Identifying degraded soils (e.g. scalded or eroded areas) and changing practice or landuse
- Adding carbon-rich materials (e.g. composts, biosolids and manures) to the soil as amendments

In Summary…

- Carbon is cycling on your farm already
- …. To change it and sequester more SOC you may need to change practice
- So what is your biggest lever?
- Remember that there may be some soil and climate factors that limit carbon sequestration
- Benefits of SOM to soil fertility and structure are from 'nutrient cycling', not necessarily from continuously accumulating carbon
- To increase SOC on your farm consider:

  right practice, right place, right time

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