FACT SHEET

SOIL ORGANIC MATTERS

FACT SHEET 4
OCTOBER 2017

Soil organic matter plays a vital role in maintaining soil functions such as supplying nutrients to growing plants, increasing plant available water, improving soil tilth and enhancing the soil cation exchange capacity (for more detail on the functions of soil organic matter see Soil Matters Factsheet #3). What is not well understood are the management practices which lead to increased levels of soil organic matter, particularly in dryland cropping soils.

The results of three long-term tillage and stubble retention trials in Australia are the best indication that soil organic Carbon stocks are not increased in a stubble retained no-till continuous cropping system. The three sites are located at Hermitage (Qld, self-mulching clay, 700mm annual rainfall, 46 years of treatments); Condobolin (NSW, sandy clay loam, 460mm annual rainfall, 16 years of treatments), and Merredin (WA, sandy clay loam, 330mm annual rainfall, 27 years of treatments). Only at the Hermitage site the decline of soil Carbon was reduced when stubble was retained and nitrogen fertiliser was applied.

Recent work undertaken by CSIRO at Harden (NSW, sandy loam, 650mm annual rainfall) has shown that soil organic Carbon stocks can be increased in a cropping system, even over a relatively short time period of 5 years, when supplementary nutrients are applied when incorporating crop residues into the topsoil (Kirkby et al. 2016). In this trial crop residues were pulverised with a flail mulcher and incorporated with a rotary cultivator to a depth of 15cm immediately after the first rain following harvest. At the time of incorporation supplementary nutrients (NPS) were applied to enhance soil biological activity to break down stubble into soil organic matter.

The trial concept by CSIRO at Harden was undertaken at eight sites in southern Australia with local Farm Groups. Four of the sites were maintained over 3 years (with SFS Vic and Tas, MSF and CWFS); the other four sites were maintained over 5 years (with EPARF at Minnipa and Hart in SA, BCG at Birchip in Vic and FarmLink at Temora in NSW). The results of the 5 years of trial work (2012 to 2016) are discussed below. Stubble treatments included removed, incorporated and left standing; additional nutrients were applied at sowing at a rate determined by the stubble load from the previous year.

Treatments applied in the trials

Stubble standing

Stubble incorporated

Stubble removed

Table 1. Soil type, GSR rainfall, annual crop type and average crop yield for the four trial sites.

Group	Soil type	pH (water)	Rainfall (GSR mm)#	Crop type and average trial yield (t/ha)				
				2012	2013	2014	2015	2016
EPARF	loamy sand	9+	244	W 1.3	W 2.5	W 3.8	W 2.8	Ca 1.0
Hart	clay-loam	8.5	270	W 1.9	B 5.9	W 4.1	Ca 0.7	W 4.3
BCG	clay-loam	6.5	182	W 1.7	B 0.3	W <0.1	W <0.1	W 3.2
FarmLink	clay-loam	5.5	350*	W 6.6	W 3.1	Ca 2.5	W 2.9	B 3.6

Average Growing Season Rainfall (2012 to 2016)

* 2016 was an extremely wet season in Temora with 685mm of GSR

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Table 2. Total soil organic C stock (Leco, 0-30cm t/ha) after five years of treatments (2012-2016)

Stubble treatment	Nutrient treatment	Soil OC (Leco) 0-30cm (t/ha)			
		EPARF	Hart	BCG	FarmLink
Stubble removed	Normal practice	38.1	50.5	31.8	42.9
Stubble removed	" plus NPS	38.3	53.0	29.8	44.0
Stubble standing	Normal practice	37.0	49.7	32.0	42.5
Stubble standing	" plus NPS	35.7	49.7	31.9	44.5
Stubble incorporated	Normal practice	37.9	51.9	30.9	39.8
Stubble incorporated	" plus NPS	39.0	53.0	31.4	41.5
Additional stubble	Plus NPS		52.6*		
	LSD (P=0.05)	***NS***	***NS***	***NS***	***NS***

* Additional treatment of double the stubble load with required NPS fertiliser at Hart only

Soil type and average GSR over the five years, crop type sown and yield are outlined in Table 1. There were no annual significant differences in treatment yield at any of the four sites.

There were no differences in total soil Carbon stocks between the stubble and nutrient treatments at the four sites after 5 years of trial work (soil sampled in March 2017) (Table 2).

Why there was a significant increase in soil organic Carbon at the CSIRO trial site at Harden and not at our four trial sites after 5 years of treatment, could be due to: (i) our treatments did not include mulching and rotary harrowing of the stubble, and (ii) additional NPS was applied immediately prior to sowing rather than after the first rain over summer. The reason we did not include a stubble mulching in our treatments was that we thought it highly unlikely that farmers in our region, who in the majority are No-Till farmers, would regard mulching and incorporation of stubble to increase soil Carbon levels a viable practice.

Soil C trial at BCG, Birchip (all treatments replicated x4)

0-10CM SOIL C CONTENT (AS %)

As a reference point to the more commonly reported soil organic Carbon values based on a percentage, the EPARF site had a soil organic Carbon content of 1.2%; Hart 1.7%; BCG 1.3% and FarmLink 1.6%. Note that these values are based on a Leco analysis for soil organic Carbon. These values are approximately 20% higher than the more traditional laboratory analysis Walkley Black.

IN FARMING PRACTICE WHAT DOES THIS MEAN?

The benefits of No-Till and stubble retention should not be underestimated – reduced erosion risk, timely sowing, stubble nutrients retained etc. are all significant benefits. However, there is little evidence that soil organic Carbon stocks are increased in a No-Till system, with or without additional nutrients.

REFERENCES

Kirkby et al. (2016) Inorganic Nutrients Increase Humification Efficiency and C-Sequestration in an Annually Cropped Soil. PLoSONE11(5): e0153698.doi:10.1371/journal.pone.0153698

For more information

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