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# FERTILIZERS AND SOIL ORGANIC MATTER

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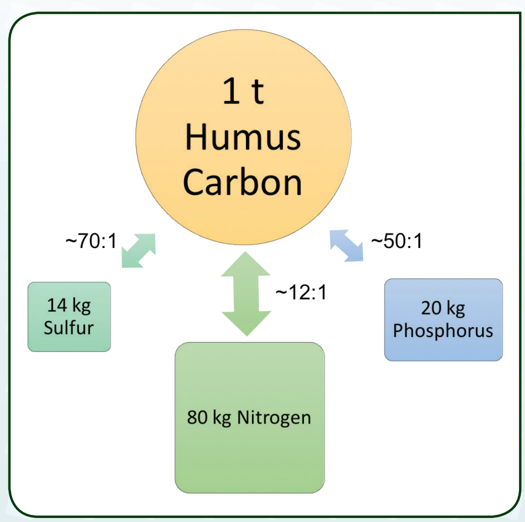
Feed the soil or feed the crop? Well – it depends on what the goal is? Many fertility programs are focused—quite rightly—on ensuring high yield and nutritious crop products. These programs identify the needs of the particular crops and balance the soil supply with additional nutrients.

But that does not necessarily mean that the same nutrient management program will increase or maintain soil organic matter. We all know that soil organic matter is important for good soil structure, water holding capacity, and is a source of nutrients, as well as a critical reserve for carbon (C). In particular, the "fine fraction" of soil organic matter (or humus) behaves as a stable and slowly decomposing organic matter pool.

This fine fraction has been shown to have a relatively constant ratio of C to nitrogen (N) to organic phosphorus (P) to sulfur (S) across a wide range of soils[1]. Each tonne of stabilized soil C (often referred to as humus) has within it 80 kg N, 20 kg P, and 14 kg S that is "locked up." But these nutrients are released as the humus-C is mineralized—something we readily acknowledge in particular for the supply of mineral N.

But the opposite is also significant. Building up this fine fraction of C in soils requires the same nutrient ratios to be available to soil microbes. The hypothesis is that the production of fine fraction soil organic matter is limited not only by C inputs, but also N, P, and S. The potential value of these nutrients in these ratios represents a strategy to sequester C and improve soil organic matter. This has been tested in laboratory incubations which demonstrated that inorganic nutrient availability is critical to sequester C into the more stable fine fraction organic matter irrespective of soil type and C input[2].

Under field conditions in Australia, soil organic C stocks in the top 1.6 m increased by 5.5 t C/ha where




*Each t of humus-C has approximately 80 kg N, 20 kg P, and 14 kg S "locked up".*

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> *“Matching the nutrient supply of added C with other nutrients is essential to increase soil organic matter.”*

supplementary nutrients were applied over five years with incorporated crop residues. In each year of this field experiment, additional N, P, and S was added to the crop residues based on the amounts required to humify 30% of the above ground stubble. Where no added nutrients were supplied, C stocks fell by 3.2 t/ha and the majority (2.9 t/ha) were lost from the top 10 cm. This amounts to a difference of 8.7 t C/ha in only 5 years even though the same level of C from residues was supplied[3].

Importantly the research has shown that nutrients provided in fertilizer not only have a critical role in crop nutrition, but also provide a valuable resource to build soil C. Nutrient inputs therefore are a big component for long-term system stability.

### References:


1. Kirkby, C.A. et al. 2011. Geoderma 163:197-208.
2. Kirkby, C.A. et al. 2013. Soil Biology and Biochemistry 60:77-86.
3. Kirkby, C.A. et al. 2016. PLOS ONE, DOI:10.1371/journal.pone.0153698.


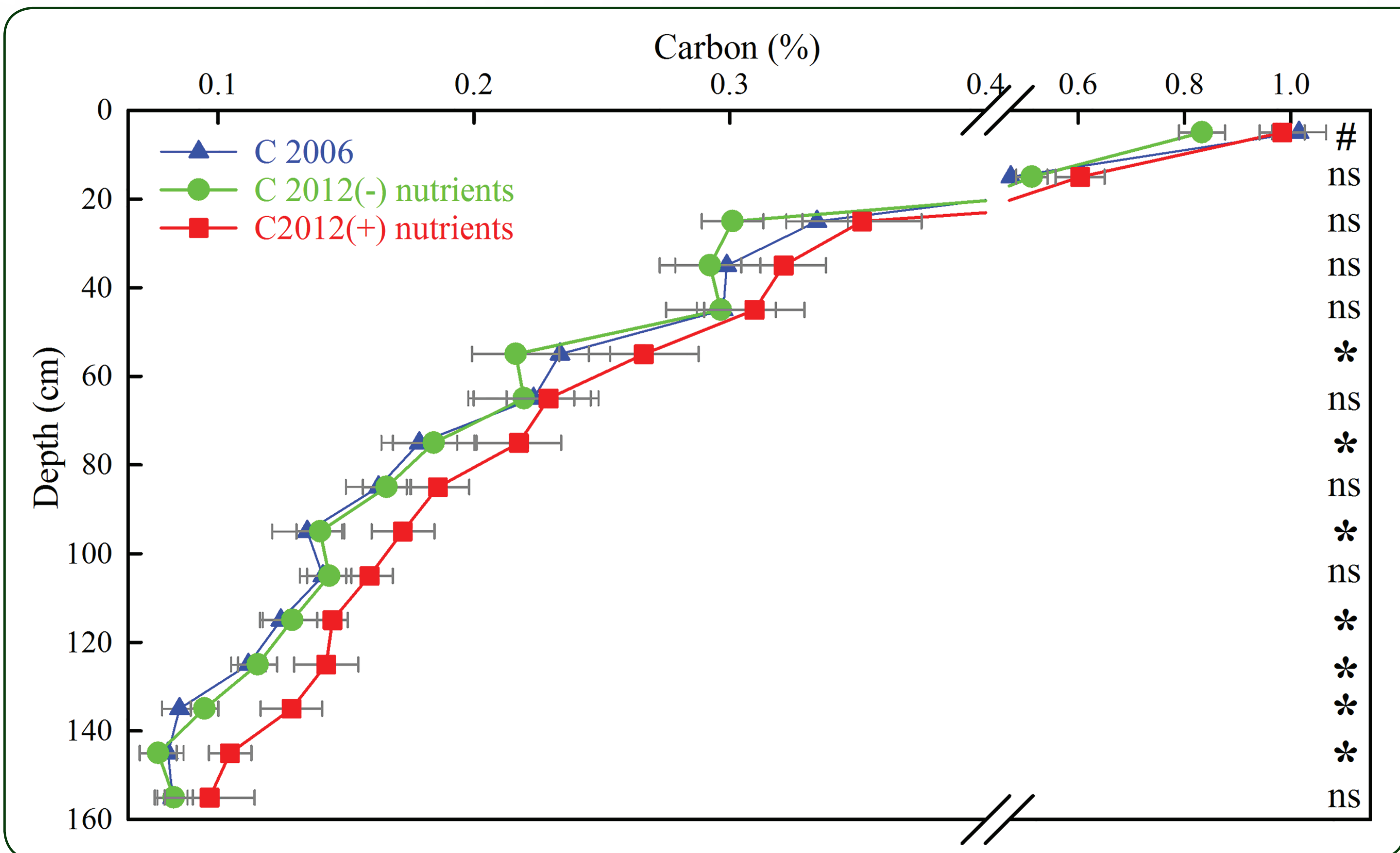


**Figure 1.** Average fine fraction C concentration (%) to 1.6 m depth in the <2 mm soil fraction in 2006 (Blue line). The (+ Red line) and (- Green line) show the nutrient treatments in 2012. The # and * symbols indicate a significant difference between the original 2006 value and the 2012 value for the (-) and (+) nutrient treatments, respectively, at $p < 0.05$, while ns indicates no significance. Source: Kirkby, C.A. et al. 2016.


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