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Carbon sequestration in crop/pasture sequences: a perspective from two long-term experiments in subtropical Uruguay

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Soil organic carbon (SOC) is a central indicator of quality and productivity of agricultural soils, and its dynamics are fundamental for sustainable agricultural production systems. Further, it can play an important role offsetting GHG emissions. Many studies have shown that soil management practices strongly influence SOC dynamics. So far, few long-term experiments have analysed how crop-pasture sequences affect SOC stocks. For better identification of these processes, it is necessary to explore different soil types, rotations, climatic conditions and duration of treatments. We aim to determine the potential of soils of Uruguay for carbon sequestration according to long term land use. For this, we analysed data from two experiments in Uruguay –one established in 1963 at INIA La Estanzuela (RV), and the other one in 1995 at INIA Treinta y Tres (PP)– to study the effect on SOC of contrasting crop/pasture sequences, from continuous cropping to permanent pastures with different duration and species composition. Samples were taken from 0 to 60 cm depth, in 4 soil layers in 2009 (RV) and 2015 (PP). Average values of soil stocks (in fixed depth) were 98.04 (±16.30) Mg C ha-1 in RV and 82.25 (± 9.13) Mg C ha-1 in PP experiment. The treatments did not affect ($p<0.05$) SOC stocks on PP, but did in RV. Our preliminary results indicate that besides duration of pasture phase, the choice of species determines the synergic relationship between crop-pasture phases and on soil C stocks.

What long term agricultural research is actually needed?

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A truly sustainable agriculture is actually easy to achieve now if one is willing to combine the best sustainable practices from conventional, organic, and agroecological approaches, and include social, economic, and political remedies. For example, synthetic nitrogen for limited responsible use can actually be produced sustainably to supplement organic sources. Rock sources with low concentrations of phosphorus and other nutrients are enough to supply crop needs, so the depletion of rich mines (“peak phosphorus”) is really not a long term threat. Soil erosion can be countered. Biodiversity, to support natural enemies that can coevolve with pests, and regional rotations can provide pest control. The world population can be fed with sustainable methods, including expected population increases, with at most modest higher costs. So what long term research is really needed? There is still a need to: reduce and recycle waste more efficiently; keep studying the soil and crop microbiome; study reduced tillage and refine weed control; study long term soil nutrient depletion; develop low-concentration fertilizer mixes to actually match what crops remove from soil; research how to counter especially persistent or damaging pests and diseases, including when they still develop resistance to biological or cultural controls; refine and promote seed saving, including free use of any genetically modified crops (if truly useful and safe); continue development of perennial crop systems; plan how to integrate local and regional production; reduce costs but also incorporate public policies that subsidize sustainable methods as needed, treating soil and agriculture as national and community treasures.