Factors driving organic matter building in degraded soils rehabilitated by organic waste addition under semiarid climate

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Introduction.

Incorporation of exogenous organic matter (OM) to degraded soils can contribute both, to recover the normal functioning of these soils and to C sequestration, as well as to correct alterations in soil physical properties and nutrient deficiencies derived from the scarcity of OM, so characteristic in degraded soils. Many studies on the rehabilitation of degraded soils by adding different types of organic wastes have highlighted the effectiveness of this strategy. However, there are gaps to be discovered, such as, for example: i) if the positive effect of the amendment is maintained over time and for how long; ii) if the type of amendment used is indifferent, only importing the amount of OM contributed with it; iii) if the effect achieved in the medium-long term vary with the application dose; iv) what is the contribution of these amendments to the increase of the soil organic C pool in the long run?

Therefore, **the objective** of this work was to clarify some of these unknowns, taking advantage of soil recovery experiments carried out by our research group, years ago.

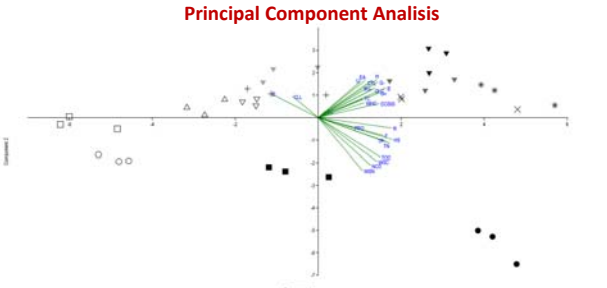
Experimental design.

Degraded soils amended, at the time, with a unique addition of organic wastes for rehabilitation purposes were selected in different areas of SE Spain subjected to semi-arid climate conditions in order to study the effect of the organic amendment (OA) at the short, medium and long-term: 1) The short-term effect (3 years) was studied in two different zones: Cartagena (Ct) and Abarán (Ab). In these areas, plots of 30 m^2 were amended 3 years earlier with 150 t ha^{-1} of goat+sheep manure compost (MC); 2) For the medium term effect (10 years), soils were collected from plots, where 120 t/ha of fresh (SS) or composted sewage sludge (SSC) were added 10 years earlier in order to assess the impact of the stability of the amendment on soil characteristics; 3) For the study of the long term effect of soil OA (28 years), soils were collected in a highly degraded zone, from plots where 28 years earlier the organic fraction of household wastes had been added at different doses (65, 130, 195 and 260 t ha^{-1}.

Results and Discussion

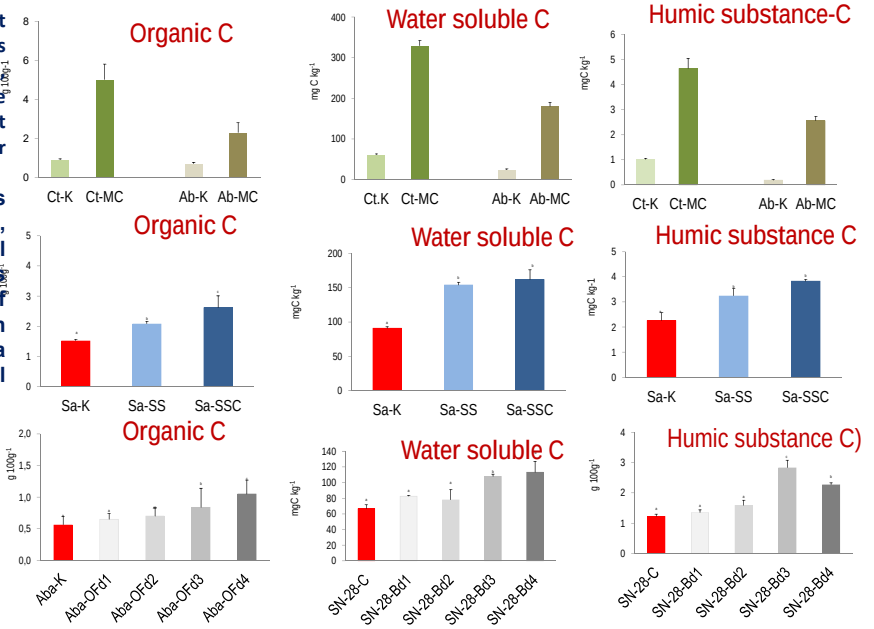
Ten years after the addition of the same OA but with different degrees of stability (fresh and composted), to a degraded soil, it was observed that the beneficial effects of the OA on soil properties, microbial populations, and the creation of a C pool, were more significant in the soils amended with compost than in those that received fresh amendment, suggesting that the stabilized OA, offer more lasting effects on soil.

28 years after the addition of the OA, the amended soils continue to show, when OA has been applied at high doses, a notable improvement of their chemical, microbiological and biochemical characteristics. It should be noted that this improvement is marked by the dose applied, high doses of OA being necessary for said improvement to be persistent in the long term, showing the soils treated at lower doses a trend, after such a long period of time, to return to its initial characteristics.



○ Ct-K ; ● Ct+MC;□ Ab-K ;■ Ab+MC; ✚ Sa-K;✖ Sa+SS; * Sa+SSC ;△ Aba-K

▽ Aba+OFd1; ▽ Aba+OFd2; ▼ Aba+OFd3; ▼ Aba+OFd4



Ct-K, and Ct-MC: control and amended soil, respectively, in the Cartagena zone 2 years after manure compost addition; Ab-K and Ab-MC: control and amended soil, respectively, in the Abaran zone 2 years after manure compost addition; Sa-K, Sa-SS and Sa-SSC: control, soil amended with fresh sewage sludge and soil amended with composted sewage sludge, respectively, in the Santomera zone 10 year after the organic amendment; Aba-K, Aba-OFd1, Aba-OFd2, Aba-OFd3 and Aba-OFd4: soil amended with 0 (control) 0,5%, 1%, 1.5% and 2% of the organic fraction of domestic waste in the Abanilla zone 28 year after the organic amendment.

The PCA discrinated clearly the amended soil from their respective controls, amended soils showing better quality tan control soils

Conclusions

- *The addition of quality OA to degraded soils produces, in the short, medium, and long-term, a considerable improvement in the soil physical, chemical and microbiological properties, favoring the creation of a C pool (increase in organic C, WSC and humic substance content).*
- *The beneficial effects of OA on soil quality persists in the medium (10 years) and long term (28 years) and is influenced by the type of soil, the nature and degree of stability of the OA and the application dose, the mechanisms through which these amendments affect the properties of the soil being different.*
- *The soil quality improvement produced by the OA incorporation, favors the development of a spontaneous vegetation, which ensures the return of OM to the soil through the root exudates and the return of plant remains, also promoting greater development and activity of soil microbial populations.*