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D5.2 Report on the presentation and analysis of the results of the soil-products interaction experiments

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The main experiments addressing soil-products interactions were conducted by URCA and IRA and are described in a paper in preparation for publication in the journal Geoderma:

Influence of biochar and compost and their interaction on carbon and nitrogen mineralization in a Saharan sandy soil

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Given the crucial role of soil organic matter (SOM) in fertility and productivity, the recycling of agricultural residues via composting or pyrolysis is a promising path in oasian agroecosystems. However, the temperature, irrigation practices and soil properties work in favour of rapid SOM degradation. Estimations of the evolution of exogenous organic matter and of the durability of their effect thus require fine study of soil-product interactions.

To this end, an incubation experiment was carried out by Élie LE GUYADER during a three-months stay at the IRA of Médenine, Tunisia. The experiment used soil collected in the oasis of El-Atilet in Kebili, Tunisia, at 2-20 cm depth and approximately 1 m from date-palm trunks, in plots that had not been amended for at least 3 years. The soil was characterized in situ and in the laboratory before the start of the experiments (bulk density, granulometry, pH, total N and gypsum contents…).

The compost was produced by the Association pour la Sauvegarde de l'Oasis de Chenini (ASOC) in Gabès, Tunisia, from crushed date-palm residues mixed with sheep manure (70:30 in volume). The biochar was produced from slow pyrolysis (2 h at 450 °C) of date-palm leave rachis, collected in the Murcia, region, Spain. Both products were characterized.

For the incubation experiment, unamended soil was used as a control. Seven combinations of biochar and/or compost, supplied to the soil with/without a pre-incubation, were used. All treatments were initially adjusted to the same water content (field capacity) and incubated at 25 °C for 4 months, during

which the water content was regularly checked and adjusted if necessary. The quantity of CO_2 emitted from SOM mineralization (and from the products in the case of a pre-incubation) was measured through the use of soda-traps. Total extractable soil inorganic N was measured regularly over the experiment.

The C mineralization dynamics was modelled and Rock-Eval thermal analysis was used to characterize the organic matter, distinguishing 5 compartments according to their thermal lability or stability, at the start, middle and end of the incubations.

The thermal signature of compost was similar to that of fresh plant material, likely resulting from a poor OM decomposition by micro-organisms during the composting process. Furthermore, it contained a high amount of soluble salts whose accumulation may degrade soil quality, as well as an important mineral fraction. Yet, compost supplied nutrients favourable to plant growth (K, P…). Its C mineralization over the incubation experiment was estimated to be 17%.

Contrarily, biochar was highly refractory. It did not induce an increase of C mineralization if applied alone. If pre-incubated with compost before application to the soil, biochar seemed to protect exogenous or soil organic matter from degradation, through physical mechanisms.

This study highlighted the need for improvements of the composting process with date palm residues, to optimise the carbon stability of compost, and to avoid salinization of the soil and water in arid areas.