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Impact of Ca-amendments and soil management in physical properties linked to soil-water relationship in degraded Ultisols from South-Europe

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Cañamero′s raña formation in western Spain was cleared for cropping in 1940′s. Its highly weathered acidic soils (Ultisols) were deeply affected by tillage. The soil organic matter (SOM) content and specially the particulate organic matter (POM), a labile fraction, were drastically reduced, and most of their chemical and physical soil properties related to its quality were negatively affected. The extraction of Ca through the harvest and the release of Al retained in organic-Al complexes resulted in a lower Ca/Al ratio which increased the Al toxicity. These effects led to a drastic yield reduction and the abandon of many degraded fields after 20-70 years of unsustainable managements.

On these degraded soils we studied the effect of different soil management strategies (no-till with wild pasture (WP) and no-till with an improved pasture (IP)), and amendment applications (sugar foam waste (SF), and SF + Phosphogypsum (PH) versus control (C)). One of the objectives of this work was to evaluate the efficiency of these practices to recover soil quality parameters, especially those related to soil-water relationship.

A Split-plot experiment was established in a degraded field. We evaluated the changes in superficial infiltration, bulk density, and content of water-stable aggregates per 100 g of soil before the Ca-amendment applications and pasture establishments, and after 4.5 years. We also measured the changes in SOM and POM contents which are closely related with the previous parameters.

The Ca applications reduced Al toxicity, improved the pasture yield and increased organic matter inputs to soil. The results showed a significant increase of POM in all treatment compared with the POM content at the beginning of this experiment. However the “SOM minus POM” which could be classified as recalcitrant organic matter did not show significant increments.

The increase of POM had a positive effect on the content of water-stable aggregates per 100 g of soil and the water infiltration which increased, and the bulk density which decreased. We recommend the use of SF for these degraded acid soils, because it improved soil-water properties and because it is a clean and inexpensive by-product. The IP cropping also assisted the soil recovery and provided pastures with higher concentration of legumes species than the WP.