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Effect of farmyard manure rate on water erosion of a Mediterranean soil: determination of the critical point of inefficacy

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Intensive cultivation of soils, using multiple soil tillage, led to the decrease of their organic matter content and structural stability in several cultivated area of the Mediterranean countries. In these degraded soils, the addition of organic products, traditionally the animal manure, should improve soil health among them the resistance of soil to water erosion. The aim of this study was to evaluate after 1 year of the addition to a cambisoil different doses of farmyard manure on soil organic matter content, on microbial activity and on aggregate stability (proxy to soil resistance to water erosion). The statistical process (bilinear model) was used to found a point at which the addition of the organic product no longer influences the soil resistance to erosion.

The farmyard manure issued from a cow breeding was composted passively during 4 months and used to amend a small plots of a cultivated cambisol (silty-clay texture, 0.9% TOC) located in the northeast of Tunisia (Morneg region). The manure was intimately incorporate to the soil. The manure organic matter content was 31%, and its isohumic coefficient was 49%. Twelve dose of manure were tested: from 0 to 220 t C.ha-1. The experiment was started on September 2011. In November 2012, soil sampling was done and soil organic carbon content (Walkley-Black method) and soil aggregate stability (wet method of Le Bissonnais) were assessed. A laboratory incubations of soil+manure mixtures, with the same proportions as tested in the field conditions, was carried at 28°C and at 75% of the mixture field capacity water retention. Carbon mineralization was monitored during three months incubation.

Results show that the addition of farmyard manure stimulated the microbial activity proportionally to the added dose. This activation is due to the presence of easily biodegradable carbon in the manure, which increases with increasing manure dose. On the other hand, the addition of manure increased the aggregate stability with the manure dose increasing. This aggregate stabilization is due to the stimulation of microbial activity (r= 0.72, n=12) which can improves the aggregate stability by increasing the aggregate cohesion by adhesive substances such as the polysaccharides and by the enmeshment of aggregate by fungal hyphea. The increase of organic matter content due to manure addition contributes also to aggregate stabilization with a high regression slope with the first manure doses (less then 120 t C.ha-1). Using a bi-linear model, reach 2.3% of soil organic carbon seems to be a critical level from which the aggregate stability evolves little.