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Soil microbial activities in Mediterranean environment as desertification indicators along a pluviometric gradient.

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In the Mediterranean areas of Southern Spain, unsuitable agricultural practices with adverse environmental conditions (López Bermúdez and Albaladejo, 1990), have led to a permanent degradation and loss of soil fertility. This includes deterioration of the natural plant cover, which protects against erosion by contributing organic matter, the main prerequisite of ecosystem sustainability (Grace et al., 1994). Physico-chemical, microbiological and biochemical soil properties are very responsive and provide immediate and precise information on small changes occurring in soil (Dick and Tabatabai, 1993). There is increasing evidence that such parameters are also sensitive indicators of ecology stress suffered by a soil and its recovery, since microbial activity has a direct influence on the stability and fertility of ecosystems (Smith and Papendick, 1993). One method for recovering degraded soils of such semiarid regions, with their low organic matter content, is to enhance primary productivity and carbon sequestration without any additional nitrogen fertilization and preferably without incorporation of leguminous plants (Martinez Mena et al., 2008). Carbon rich materials can sustain microbial activity and growth, thus enhancing biogeochemical nutrient cycles (Pascual et al., 1997).

The present study is focused in the role of physico-chemical and microbial soil properties in Mediterranean environment, in terms of in situ and ex situ microbial transformation of soil carbon and nitrogen, in order to characterise the key soil microbial activities which could strongly affect carbon and nitrogen turnover in soil and hereby soil fertility and soil organic matter “quality”. These microbial activities could at unsuitable agricultural practices with adverse environmental conditions induce unfavourable hydrologycal tempo-spatial response.

The final results shown modifications in the soil properties studied with the increasing of the aridity. Such changes suppose the soil degradation what make us the existence of soil degradational processes. Physico-chemical properties and soil microbiological activities analysed shown a higher relationship tend to the soil degradation along a pluviometric gradient selected. Biothic and abiothic factors are going to be more degraded conditions according with a reduction of pluviometric conditions. The soil degradation observed across the analysis of the more stable soil properties, that we can denominate from the slow cycle, bring as a consequence an important reduction of the vegetation cover, and therefore in the soil protection, decreasing their soil moisture content and their soil permeability and the cationic exchange capacity, as good key factor to determine the soil health. When these processes take place, an increase of runoff, high pedregosity and crusting may occur in the soil surface.

Concerning the regional scale spatial variability, results of experimental field work conducted along a climatic transect, from the Mediterranean climate to the arid zone in the south of Spain, show that: (1) organic matter content, and aggregate size and stability decrease with aridity; (2) the rate of change of these variables along the climatic transect is non-linear and (3) the analysis of the soil properties shown a higher and inverse correlation between soil degradation levels and organic carbon sequestration capacity; (4) the soil respiration were tightly coupled with the carbon compounds available in soil (5) the in situ ammonification was nearly the same along a pluviometric gradient; (6) the nitrification was increasing with aridity identically in control soils, and after the addition of cellulose and raw silk; (7) the contact time of the water with the soil matrix was sufficient to retain NH4+, but insufficient for a retention of NO3-. (8) the key factor influencing the movement of nitrate and thereby promoting the losses of base cations was the frequency and intensity of precipitation not only a soil-internal N surplus.

A steplike threshold exists at the semiarid area, which sharply separates the Mediterranean climate and arid ecogeomorphological systems (Lavee et al., 1998). This means that only a relatively small climatic change would be needed to shift the borders between these two systems.

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