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Improving soil physical properties related to hydrological behaviour by inducing microbiological changes after organic amendments

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The application of exogenous organic matter to degraded soils is a feasible practice to improve soil conditions and to minimise erosion rates. Different organic refuses, such as municipal solid wastes, sewage sludge or poultry manure, uncomposted or composted, have been tested for soil reclamation with good results. Aggregate stability in degraded soils under semiarid conditions is one of the key characteristics determining the movement and availability of water. Here we report the results of a study of the application of three different organic wastes (two sewage sludges composted (LA) and (LB) from different water plant treatments and one uncomposted (LS) from one of those plants) in an abandoned agricultural soil under semiarid conditions. Biological and physical soil properties related to water availability and hydrological processes were monitorized during 3 years and their relationships were studied.

The study area was located in "El Campello", Alicante, southeast of Spain. The soil had a low initial organic matter content (1.7%), a loamy texture, low nutrient content and a high percentage of carbonates (69%). Mean annual rainfall of the area is around 300 mm. Twelve plots of 9 m^2 were established in field conditions (3 per treatment and 3 controls (C- without treatment)). A unique low dose of 3 kg m^{-2} of each organic waste was applied in the beginning of the experiment (July 2000) without mixing with topsoil. The soil parameters studied were: soil organic matter (SOM), soil

microbial biomass (SMB), basal soil respiration (C-CO_2), enzymatic activities (urease, BAA-protease and phosphatase), water holding capacity (WHC) and aggregate stability (AS).

In the first samplings after waste application, beneficial effects were found since the values of the microbiological and biochemical parameters had increased. Aggregate stability % has been extensively used in restoration experiments to measure erodibility of soils, and in this case a positive correlation between aggregate stability and soil microbial biomass was found (r^2*=0.92, at P<0.001*) for the first samplings of the first year. After almost 3 years of application (may 2003), most of the soil indicators keep differences with control plots. SOM content was 4-fold higher in all of the different treatments in relation to the control, C-CO_2 and enzymatic activities were considerable higher in treated plots being the phosphatase the one most favoured by the treatments. WHC increased from 48% to 62, 52 and 67% for LA, LB and LS respectively. The vegetation recovery induced by the waste application has re-activated the inputs of organic matter to the soil promoting microbial activity and slowing down degradation processes.

The different organic refuses added to the soils have shown different mineralization patterns, influenced by C/N of the refuses, their easily biodegradable organic compounds, and the size of the organic material added. We think that the size of the organic wastes has been a very important factor. LS refuse has a too low surface-to-volume ratio in relation to LA and LB refuses, where microbial attack was more effective. For this reason, the mineralization velocity of the composted refuses was higher than the velocity of the uncomposted ones.

In this study the unique dose of treatments has caused an improvement in soil conditions with all types of wastes that can be useful to increase cover vegetation of soil, increasing the water availability for plants by modifying soil physical structure. This situation can help to reduce soil losses by erosion in Mediterranean environment.