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Assessing different agricultural managements with the use of soil quality indices in a Mediteranean calcareous soil

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Soil erosion is a major problem in the Mediterranean region due to the arid conditions and torrential rainfalls, which contribute to the degradation of agricultural land. New strategies must be developed to reduce soil losses and recover or maintain soil functionality in order to achieve a sustainable agriculture. An experiment was designed to evaluate the effect of different agricultural management on soil properties and soil quality.

Ten different treatments (contact herbicide, systemic herbicide, ploughing, Oat mulch non-plough, Oats mulch plough, leguminous plant, straw rice mulch, chipped pruned branches, residual-herbicide and agro geo-textile, and three control plots including no tillage or control and long agricultural abandonment (shrub on marls and shrub on limestone) were established in 'El Teularet experimental station' located in the Sierra de Enguera (Valencia, Spain). The soil is a Typic Xerorthent developed over Cretaceous marls in an old agricultural terrace. The agricultural management can modify the soil equilibrium and affect its quality. In this work two soil quality indices (models) developed by Zornoza et al. (2007) are used to evaluate the effects of the different agricultural management along 4 years. The models were developed studying different soil properties in undisturbed forest soils in SE Spain, and the relationships between soil parameters were established using multiple linear regressions. Model 1, that explained 92% of the variance in soil organic carbon (SOC) showed that the SOC can be calculated by the linear combination of 6 physical, chemical and biochemical properties (acid phosphatase, water holding capacity (WHC), electrical conductivity (EC), available phosphorus (P), cation exchange capacity (CEC) and aggregate stability (AS). Model 2 explains 89% of the SOC variance, which can be calculated by means of 7 chemical and biochemical properties (urease, phosphatase, and ß-glucosidase activities, pH, EC, P and CEC). We use the residual (difference between calculated SOC by models and real SOC, analyzed in laboratory) as soil quality indices. We consider higher soil quality when the residuals are closer to cero or inside confidence intervals of the models (95%).

As expected, the application of the models indicates that in all the treatments and the control plots (shrub on marls and shrub on limestone), the residuals are out of the confidence intervals for the models, showing a disequilibrium among soil properties because these treatments have been submitted to a perturbation such as the agricultural use. However, it can be observed that the residuals in the last sampling in control plots and some of the treatments, the least aggressive with the soil, are lower and therefore the soil it seems to the soil properties is achieving to their equilibrium among them. These soils are: Shrub on limestone and shrub on marls, Chipped pruned branches and Oat mulch non-plough. These results are in agreement with García-Orenes et al. (2010), who showed that the addition of oat straw to soil can be considered an effective soil management, because it produced an important increase of the different fractions of organic carbon and microbial activity, that it will be translated into a rapid improvement of soil quality. The application of the herbicides studied produced a decrease in all the soil parameters; these practices are not recommendable for a sustainable agricultural system in semiarid Mediterranean agro-ecosystem.

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