



Amendments and mulches improve the biological quality of soils degraded by mining activities in SE Spain

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Mining and quarrying activities generate negative visual impacts in the landscape and a loss of environmental quality. Substrate properties at the end of mining are in general not suitable for plant growth, even native ones. In an experimental soil restoration in limestone quarries from Sierra de Gádor (Almería), SE Spain, the effect of organic amendment (sewage sludge, compost from the organic fraction of domestic waste or non-amendment) combined or not with two different kind of mulches (fine gravel, chopped forest residue) was tested by triplicate in 5 x 5 m plots with the aim to improve soil/substrate properties and to reduce evaporation and erosion. In each experimental plot 75 native plants (*Stipa tenacissima*, *Anthyllis terniflora* and *Anthyllis cytisoides*) were planted. Effects of adding organic amendments and mulches on some soil microbiological and biochemical parameters (microbial biomass carbon, basal respiration and different enzymatic activities, such as dehydrogenase, phosphatase, β -glucosidase and urease) were analyzed 5 years after the start of the experiment. Vegetation growth was also monitored. The two-way ANOVA, using as factors amendment and mulch, showed a significant positive influence of organic amendments on microbial biomass (C_{mic}), basal respiration and some enzymatic activities related to the cycles of C and N. The highest values of these parameters were obtained with compost. The influence of the mulch factor and its interactions with the amendment factor on the measured variables did not follow a clear trend with respect the measured parameters. Mulching did not improved significantly ($p < 0.05$) the positive effect of organic amendments on C_{mic} although C_{mic} values increased with the incorporation of "forest chopped residue" and decreased with gravel incorporation. In general, both type of mulch decreased or have no effect on the microbial activity detected in the amended soils, with the only exception of the forest chopped residue, which increased phosphatase activity in the compost amended soil. Plant growth was significantly higher in amended soils than in the control, but it is remarkable that the mulch type "forest chopped residue" had a negative effect on vegetation growth. The addition of organic amendments, especially compost from the organic fraction of domestic wastes, is beneficial to restore degraded or man-made soils from quarrying areas because they stimulate microbial growth and activity, resulting in mineralization of nutrients necessary for plants and increasing soil fertility and quality. However, after 5 years the effects of the mulch "forest chopped residue", on the improvement of soil or substrate quality are not clear.