Geophysical Research Abstracts
Vol. 18, EGU2016-4037, 2016
EGU General Assembly 2016

Response of the soil physical properties to restoration techniques in limestone quarries

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The devastating effects of soil erosion in mining areas from arid/semiarid environments have prompted efforts geared toward an improvement of the soil physical conditions for a fast establishment of vegetal cover. Restoration practices that increase soil moisture content are essential in drylands where rainfall is irregular or insufficient in order to accelerate ecological restoration. The aim of this study was to analyse the influence of organic amendments and mulches on the soil porosity as well as their impact on infiltration, five years after the beginning of an experimental restoration from limestone quarries in Sierra de Gádor (Almería, SE Spain). Nine plots 15 x 5 m were prepared at the site in a completely randomized 2 x 3 factorial design. The first factor, organic amendment, had three levels: sewage sludge (SA), compost from domestic organic residues (CA) and no amendment (NA). The second factor, mulches, also had three levels: gravel (GM), woodchip (WM) and no mulch (NM). In each experimental plot 75 native plants (Macrochloa tenacissima, Anthyllis terniflora and Anthyllis cytisoides) were planted. Infiltration was determined from rainfall simulations and soil porosity was assessed by image analysis of soil thin sections. Total porosity and pores distribution were measured according to pore shape (regular, irregular and elongated) and size (transmission pores [50-500 μm] and fissures [>500 μm]). Natural undisturbed soils around the mine area were used as a reference soil (RS). Restoration treatments showed higher total porosity, fissures and elongated pores than RS and we observed the highest values in treatments with WM. This fact is due to the disruption caused by the application of treatments rather that a good soil structure. Each combination exhibited different values of transmission pores, being greater in the combinations of NA-GM, SA-NM and CA-WM. Infiltration increased with the increase of the total porosity, fissures and elongated pores, especially in treatments with organic amendments and woodchip mulch. While in plots with this mulch, the wetting front only reaches a few centimetres in depth. This was probably due to the preferential orientation of woodchips pores parallel to the soil surface, which decreases the percolation to deeper soil layers. Neither treatment reached a wetting front like RS but, in view of the parameters related to good physical soil properties (pores distribution, infiltration and wetting front depth) the combination of SA-NM can allow a high soil moisture content to facilitate the plant cover establishment. It is right to conclude that sewage sludge is the most adequate treatment for restoring areas degraded by mining activities in a semiarid climate.