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Wildfire effects and temporal changes of water repellency in a gypsiferous soil

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Soil water repellency (WR) is a property that can change with the passing of a fire, usually increasing, but the degree of change depends on several factors including fire severity, type of vegetation burned, and soil type (Doerr et al., 2000). Acidic and sandy soils are the most prone to develop water repellency but it has also been detected in calcareous and finer textured soils (Mataix-Solera and Doerr, 2004). Although most of studies have found a WR increase as consequence of fire, some others showed the opposite pattern, i.e. a reduction of WR because the fire in previously water-repellent soils (e.g. Márquez et al., 2011), or no changes, as the findings of Mataix-Solera et al. (2008), who found that in some cases soil properties such as clay content and mineralogy make the soil less susceptible to becoming water-repellent by burning as in Terra Rossa soils of Mediterranean areas. The objective of this research is to study the fire effects on WR in gypsiferous soils since very little is known about WR in this type of soils.

In August 2009 a large forest fire affected 6700 ha in Remolinos (NW Zaragoza, Spain), with cover consisting of shrubs such as gorse (Genista scorpius L.), broom (Retama sphaerocarpa L.) and rosemary (Rosmarinus officinalis L.), and with small areas occupied by Aleppo pine (Pinus halepensis Mill.) and Kermes evergreen-oak (Quercus coccifera L.). This region has a semarid Mediterranean climate, with an average annual rainfall ca 560 mm and a mean annual temperature of 12.5ºC. The potential annual evaporative demand, estimated by Thornthwaite method is ca 950 mm. The relief consists of stepped slopes (200-748 masl) and the lithological substrate consists of limestones and gypsierous marls, dated from the middle Miocene. An area with soil developed on gypsum was sampled immediately after fire and monitored (burned and unburned areas) during one year to study the soil WR. Samples were also taken differentiating as to beneath pine and shrub. The study seeks to understand the behaviour of WR over time, and also its behaviour in soil depth. Samples were taken using cylinders of 5 cm depth. WR was measured under laboratory conditions using the WDPT test in 5 subsamples of each cylinder after separating every sample per cm of depth.

Main results can be summarized with the following data: the unburned (control) area showed hydrophilic conditions (WDPT <5s) during the whole study period and at all depths studied. Fire produced a development of surface WR with initial mean values of 186 s for the samples taken beneath pine and 21 s for those taken beneath shrub in the upper layer of burned area immediately after fire. With the passing of time, WR decreased in the topsoil but increased in the second and third cm depth indicating a downward movement of organic hydrophobic compounds after the first rainfall periods. Seasonal changes showed higher WR values after dry periods.

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