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Fire effects and short–term changes on water repellency in a Lithuanian grassland soil

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Soil water repellency (WR) can influence soil hydrological properties because it reduces infiltration and enhances surface runoff, and consequently soil erosion. Soil WR has important implications for water available for plant growth and soil surface and subsurface hydrology. It is well-known that fire can induce, enhance or destroy soil WR depending on temperatures reached. This has been studied in several ecosystems, especially in the Mediterranean. Nevertheless, few studies have been done on fire effects on WR in temperate-boreal ecosystems. The aim of this work is to study the effects of fire and short-term changes on WR in a Lithuanian grassland soil. The fire occurred on April 14th 2010 in an urban/forest interface due to unknown causes and affected an area of 4 ha, in a recently abandoned agricultural field. Spring grassland fires are quite common in Lithuania and frequently became uncontrolled and have serious economical and social impacts. Four days after the fire we collected 20 soil samples (0-5 cm depth of A mineral horizon) on a gentle slope from the fire-affected area, and another 20 soil samples from a contiguous control (unburned) area with the same soil and geomorphological characteristics. In the burned area we identified the ash colour that covered the soils and we measured ash thickness. Soil samplings were repeated in the burned area 2 and 5 months after the fire. In the laboratory the samples were air dried at room temperature (20-25ºC), sieved carefully to <2 mm and exposed to a controlled laboratory atmosphere (20ºC and 50% of relative humidity) during 3 days previous to making the WR measurements, except for an aliquot of each sample that was dried at 105ºC to measure soil water content. Soil WR was measured in all samples with the Water Drop Penetration Time test (WDPT). The statistical comparisons between control, burned, burned 2 months and burned 5 months were performed with Ln transformed data after checking different transformation to fit a normal distribution with the Shapiro–wilk test. An ANOVA One-Way test was used.

The ash that covered soil samples was in the majority black (45%), light grey 35%, white 15% and in lower percentages, dark gray (5%). On average, in all ash samples, ash thickness was 14.3 mm. Per ash colour group, black ash had 18.9 mm, light gray 10.9 mm, white 5.33 mm and dark grey 24 mm.

In the control area, soils were classified as hydrophilic in 85% of samples (<5s) and only 15% of samples were water repellent (in the lowest classes of WDPT, from 10 to 60 s). The fire increased the WR to 75% of samples with a WDPT = 55 s as average value for burned samples, that slightly decreased two months after the fire (60% of water repellent samples; mean value of WDPT = 22 s). However, five months after the fire soil WR increased considerably showing WR in 85% of samples and with higher values of WDPT (mean value of WDPT = 320 s). Soil water content varied from 25% in control to 14% in recently burned and 17% and 9% in the burned at 2 and 5 months respectively. We identified a significant negative correlation (-0.71, N= 80; p<0.01) between soil water content and Log WDPT. We classify the fire as of low severity taking into account the soil water content and the ash colour measured. With these data we suspect that changes in WR immediately after fire were caused only as an indirect consequence of the loss of water due to the heat supplied by the fire. The increase observed in the samples taken 5 months latter seems to be a consequence of the dry period previous to the sampling. In addition, we observed that ash thickness presents a positive correlation (0.69, p<0.01) with soil water content. This reflects the importance of ash in increasing the water content of the soil, which can thus reduce the potential WR that can be present in this type of soil. Further studies are ongoing to verify the hypothesis suggested with these preliminary results.