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Effects of Heat on Surface Water Repellency and Aggregate Floatıng in Eucalyptus Forest Soil

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Abstract

Soil water repellency (SWR) is the resistance of soil for spontaneous wetting induced by the presence of organic substances. The soils beneath various plant species such as Eucalyptus, Cypress, and Pine are in general naturally water repellent. Wildfires are common in these forests due to the waxy nature of their plant debris. The heat generated during wildfires alters soil parameters, including SWR and stability of aggregates, depending on the heating dynamics of fire. Both heat and heat-induced changes in SWR may influence aggregate wetting and result in the floating of aggregates in the topsoil (crumbs). With runoff in sloppy lands, floating aggregates can cause severe erosion during high-intensity rainfall incidents. The present study aimed to evaluate the effects of different heating temperatures and exposure times on SWR and floating of surface crumbs using Eucalyptus forest soil. Water repellent crumbs (diameter:3-5 mm) gathered from the soil surface (0-5 cm) of *Eucalyptus grandis* forest (soil texture:sandy loam) in upcountry Sri Lanka (06° 47′ 45.2″N 80° 58′ 00.9″E) were heated up to three different heating temperatures (150° C, 200° C, 250° C) with 30 min, 60 min, and 120 min durations of exposure. The SWR and aggregate floating time (AFT) were measured 16 h after heating using the water drop penetration time test (WDPT) and immersing aggregates in water to measure AFT (up to 3 h), respectively, and compared with non-heated aggregates (control). Initially, crumbs were severely water repellent (WDPT: ~2,000 s) and showed an AFT of ~3,500 s. Crumbs were strongly water repellent at 150° C under all durations of exposure (310 s, 110 s, 260 s, respectively). Aggregates showed strong SWR (~80 s) at 30 min exposure, and slight SWR at 60 min and 120 min (~14, ~4 s) exposure under 200° C. SWR was completely eliminated at 250° C. AFT increased to >3 h, with heating up to 150° C and 200° C under all three durations of exposure and started to decrease at 250° C with 30 min exposure to be completely eliminated at 60 and 120 min exposure(0,0 s). SWR and AFT showed a positive correlation before (R^2=0.64) and after (R^2=0.59) heating. Both SWR and AFT decreased with heating temperature and duration of exposure to heat. Further experiments are required considering soil depths below 5 cm to understand the behaviour of less repellent under-surface aggregates upon exposure to heat.

Keywords: Heating temperature, Duration of exposure, Floating of aggregates, Soil water repellency