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Impact of Heat on Soil Water Repellency in Forest Soils from Different Depths using Water-Repellent Japanese Cedar (*Cryptomeria japonica*) Forest Soil

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Abstract

Some soils under plant species, such as casuarina, pine, eucalyptus, cedar, and cypress, show water-repellent conditions. Wildfires are common in forests dominated by these plant species as they produce highly flammable debris. The heat generated during wildfires alters soil characteristics, including soil water repellency (SWR). The responses of SWR to heat can differ depending on the heating temperature and the soil depth. This study aimed to examine the effects of different heating temperatures on SWR through a soil profile using Japanese cedar (*Cryptomeria japonica*) forest soil in Japan. Soil samples were collected from four different depths (0-5, 5-10, 10-15, 15-20 cm). Soils were exposed to heat with seven heating temperatures (T_H) (50, 100, 150, 200, 250, 300, and 350° C) separately for 1 h using a programmable muffle furnace. The degree (contact angle) and the persistence of SWR in both heated and non-heated samples were measured using the molarity of an ethanol droplet test and the water drop penetration time (WDPT) test, respectively. In non-heated soils, the 0-5 cm layer showed the highest SWR (contact angle ~110°; WDPT≥3600 s). SWR decreased with depth to be non-repellent at 15-20 cm (contact angle≤90°; WDPT≤1 s). In heated samples, SWR of 0-5, 5-10, and 10-15 cm layers decreased with increasing T_H, while the selection from 15-20 cm was non-repellent in all treatments. Soils of 0-5 cm depth showed extreme SWR (WDPT=≥3600 s) up to 200° C and became non-repellant at 250° C, while those of 5-10 cm showed extreme SWR up to 150° C, severe SWR (WDPT~1350 s) at 200° C, and became non-repellent at 250° C. The soils from 10-15 cm showed severe SWR (WDPT~2100 s) at T_H of 50° C and became non-repellent at 100° C. Results revealed that upper soil layers with higher SWR required higher T_H to become non-repellent, and soils from lower layers with lower SWR became non-repellent at lower T_H. Further experiments are necessary to identify the changes in molecular levels of organic matter in response to the impacts of heat on SWR.

Keywords: *Cryptomeria japonica*, Laboratory heating, Soil water repellency, Wildfires