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Soil Profile Moisture Distribution in Relation to Water Repellency in an Upcountry Eucalyptus Plantation Forest Soil in Sri Lanka

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Abstract

Eucalyptus (*Eucalyptus grandis*) is grown in upcountry of Sri Lanka, with the objective of reducing the degradation of lands. In these soils, water repellency has been identified as a severe problem. Soil water repellency is a dynamic phenomenon, which is caused by organic matter present in soil and may affect all the hydrological properties and processes in soil. This study was conducted to examine the moisture content in the soil profile in relation to water repellency of soil in Eucalyptus plantations, using laboratory experiments and onsite soil moisture content determination. Soil samples were collected from 0-5, 5-10, 10-15 and 15-20 cm soil depths in four blocks (12 samples per block). Soil-water contact angles were determined by the sessile drop contact angle method using digital microscopic camera. Onsite volumetric water content (WC_V) was determined using TDR moisture meter. The soil water contact angle showed the highest value in the 0-5 cm soil layer (100±10°) and decreased gradually with the depth. The WC_V showed a range from about 10-22%. The average WC_V was high at the top (0-5 cm) layer. The WC_V first decreased with depth, and again increased, showing a moderate polynomial relationship (R^2 =0.43). The highest WC_V was observed in the 15-20 cm layer (16±2%), which was not significantly different from that of the 0-5 cm layer (15±4%). The lowest moisture levels were observed in the 5-15 cm depth (12±1%). The results revealed a moderate polynomial relationship between volumetric water content and water repellency in the soil. Eucalyptus dry litter and root exudates release high amounts of hydrophobic organic materials to the soil, resulting a water repellent feature. These hydrophobic coatings and interstitial organic substances act as barriers for free water movement through the soil pores resisting evaporation. In the lower layers, although water repellency was low due to less availability of organic materials, WC_V was high probably due to high clay content, which increased with soil depth. The restriction to removal of water from the top soil might affect the plant water uptake as well, limiting the growth of understory. Although this study was conducted during the wet season, when rainfall was abundant, water contents in the soil was very low (10-17%), confirming the impact of water repellency on the moisture levels of the soil profile.

Key words: *Eucalyptus, Soil water contact angle, Soil water retention, volumetric water content*

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