

Water-dependent repellency in a Eucalyptus plantation forest soil in upcountry Sri Lanka

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Abstract

Soil water repellency (SWR) is a natural phenomenon reduces the rate of wetting and retention of water in soil caused by the presence of hydrophobic coatings on soil particles. It varies non-linear with the changes in soil moisture content, where the relation can be shown in water-dependent repellency curves (WRC). In general, SWR does not show at soil moisture contents near saturation and increases with drying to a maximum with drying, and may or may not reach non-repellent levels with extreme drying. The WRC, and the parameters associated with the curve, can be used as indicators of the magnitude and the extent of water repellency over changing field moisture contents in soils. The objective of this study was to determine the WRC in a Eucalyptus plantation forest soil in Diyathalawa by gradual drying of soil samples pre-wetted until the disappearance of SWR obtained from 0–5 cm soil layer. The drying process was conducted under controlled conditions of temperature and humidity using a controlled environmental chamber with two temperatures (20 °C, 30 °C) and two RH levels (40%, 60%) separately under four environment scenarios (20 °C, 40% RH; 20 °C, 60% RH; 30 °C, 40% RH; 30 °C, 60% RH). The environment scenarios were selected considering the possible varying environment conditions of the area. While gradual drying, sub samples were taken to measure the moisture content and the SWR using water drop penetration time (WDPT) test, and the WRC was developed. Using the WRC, critical water content (CWC), maximum potential water repellency (MWR), water content at MWR (WC_{MWR}), and area below the curves (A_{WRC}) were determined. SWR at all four conditions varied nonlinearly with decreasing soil moisture. The initial water content at non-repellent wet condition was 35 %. With gradual drying of the soils, SWR appeared, reached a maximum level, and decreased again. Under the four environment scenarios, the CWC were in a range of 27–33%, the WC_{MWR} were in a range of 12–15%, and the MWR were >7200s. Changing in the environment conditions do not cause considerable change in the range of water contents that the soil showed SWR, or the MWR. It can be concluded that the soil will show water repellent conditions at most field moist conditions, except at very wet situation which may occur only in event of extended heavy rainfall to wet the soil, enough to exceed CWC.

Keywords: Eucalyptus, Humidity, Moisture Content, WDPT, Water dependent repellency

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