Existence of water repellency and its relation to structural stability of soils in a tropical Eucalyptus plantation forest

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Abstract

Water repellency is a globally well-known phenomenon in soils that is found to have direct or indirect impacts on vast majority of soil characteristics and dynamics. In this study, we aimed to examine the influence of soil water repellency on the structural stability of soils considering water stability of aggregates at the depths of 0–5, 5–10, 10–15, 15–20, and 20–25 cm. A Eucalyptus plantation forest characterized by steep slopes was selected for the study and the land was separated into three blocks (B1, B2, B3) considering the slope. The percentage of water stable aggregate (%WSA) was determined using a wet sieving apparatus. Water repellency in soils was examined using the water drop penetration time (WDPT) test and the sessile drop contact angle method. The water repellency and the organic matter content were highest in the topsoil (0–5 cm) and decreased with increasing soil depth showing strong negative exponential relationships. The clay content of B1 and B2 soils increased, and that of B3 decreased with increasing depth. The %WSA of the soils was very high showing >85% on the topsoil layer (0–5 cm), and >70% throughout the profile. Below 15 cm, B3 soils showed significantly higher water repellency compared with B1 and B2, however, showed no significant difference in %WSA compared with B1 and B2 soils. Although the primary cause of the reduction in the water repellency and %WSA with increasing soil depth seems to be the decrease in organic matter content, clay content can also be considered to have a pronounced influence. Despite the fact that the %WSA was very high on the surface, topsoil evidenced severe erosion corroborating that the improved stability of aggregate governed by water repellency does not necessarily lower the erosion. The %WSA might not be an effective indicator of the susceptibility to topsoil erosion in lands with steep slopes (>10°). Severe erosion in these sloped lands can be considered as resulted by the detachment of aggregates without disintegration, due to low cohesiveness and ease of detachment of aggregates as instigated by water-repellent conditions.

Keywords: Contact angle, Eucalyptus grandis, Soil water repellency, Water stable aggregates, WDPT