

Effect of water content on the soil water repellency for Japanese and New Zealand volcanic ash soils

KURODA, Takuya^{1*}, SUBEDI, Shaphal¹, KAWAMOTO, Ken¹, Karin Muller³, B.E. Clothier⁴, Syuntaro Hiradate⁵, HAMAMOTO, Shoichiro¹, KOMATSU, Toshiko¹

¹Graduate School of Science and Engineering, Saitama University, ²Institute for Environmental Science and Technology, Saitama University, ³Plant & Food Research Institute, Ruakura Research Centre, East Street, Hamilton 3240, New Zealand, ⁴Plant & Food Research Institute, Private Bag 11600, Palmerston North 4442, New Zealand, ⁵Biodiversity Division, National Institute for Agro-Environmental Sciences (NIAES)

Water repellency (WR) of soil can induce significant hydraulic problem such as reduced water infiltration, enhanced surface runoff and erosion and the forming of preferential flow patterns in soils. Soil water repellency is reported in many parts of the world at different climatic conditions and soil types. Although WR has been observed in many countries including Japan and New Zealand, relatively few studies evaluated WR of aggregated volcanic ash soils. In the present study, the effects of water content on the water repellency of Japanese and New Zealand volcanic ash soils at different depths were investigated. Secondly, the time dependency of the contact angle in these soils at different water contents was evaluated. The degree of water repellency of the moisture content adjusted samples was assessed with the sessile drop method (SDM), the molarity of ethanol droplet (MED) test and the water drop penetration time (WDPT) test. The degree of WR varied considerably by region and depth. For the Japanese volcanic ash soils, the contact angle increased sharply with increasing water content, reached the maximum contact angle at water contents around 0.3 cm³/cm³, and then gradually decreased to 0° at field water content. A similar pattern was found for the New Zealand volcanic ash soils. However, the contact angle of the New Zealand volcanic ash soils was greater than 100° at field water content. Directly measured contact angles using the SDM were in good agreement with indirectly obtained contact angles using the MED test. The contact angle sharply decreased with soil-water contact time in volcanic ash soil samples at higher water contents.

Keywords: soil water repellency, volcanic ash soil, sessile drop method, water droplet penetration test, molarity of ethanol droplet test