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Effect of Organic Matter Content at Different Stages of Decomposition on Soil Hydrophobicity

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Abstract

If a solid is not completely wettable by water, it is considered to be water repellent or hydrophobic. Organic matter in soils is found be highly related to the soil hydrophobic conditions. Several studies showed that hydrophobicity is positively correlated with the soil organic matter (SOM) content while some others have found more complex relationships. The objective of this study was to examine the relation of SOM content at different stages of decomposition to soil hydrophobicity under laboratory conditions. Soils were taken from the Wilpita Natural Forest in Matara District, low country wet zone of Sri Lanka. The Great Soil Group was Red Yellow Podzolic soils (USDA Soil Taxonomy classification: Udults). Soil was air dried under the laboratory conditions (74±5% relative humidity at 28±1°C) and passed through 2 mm sieve. Two different types of organic manure, namely, cattle manure (CM), goat manure (GM), and leaves of Casuarina (Casuarinaequisetifolia) (CE), were thoroughly air dried, grinded using a mechanical grinder, sieved with 1 mm sieve, and mixed with soil in 5 different percentages (0, 5, 10, 25, and 50%). The hydrophobicity of samples was measured using the water drop penetration time (WDPT) test. About 5 g of air-dried samples, in triplicates, was taken to weighing bottles. One drop (50±1 µL) distilled water was placed on the soil surface. Time taken for penetration of the water drop was measured. The SOM content of samples was measured colorimetrically and loss on ignition method. All the measurements were taken, in triplicates, at 1, 3, 7, 14, and 30 d. Hydrophobicity of all the soil samples amended with different types of organic manures (CE, CM, and GM) showed positive correlation with SOM content at all stages of the decomposition process. Initial WDPT increased with increasing SOM content. The slope of the linear regression line was 28–44% steeper for CE amended samples compared with those amended with CM and GM. The CE amended samples showed significantly higher ($p<0.05$) hydrophobicities at the same SOM content than those with CM and GM (at 15–16 g 100 g^{-1} SOM, the WDPT of CE samples = 1400 s, WDPTof CM, GM= 20–30 s). Results revealed that soils amended with CE acquired high initial hydrophobicity compared with those amended with CM and GM. This can be considered as governed by the original hydrophobicities of added manures (WDPT>3 h for 100% CE; WDPT=3–5 min for 100% CM and GM). Intermediary and ultimate hydrophobicities showed a positive linear correlation ($R2= 0.85–0.95$) with SOM content of samples with no significant differences among type of the amended manure.Difference in the slopes of the linear regression lineswere<20% and <10% for intermediary and ultimate relationships, respectively. Therefore, it is clear that intermediary or ultimate hydrophobicities of the samples are related more to the SOM content than to the composition of SOM, while initial hydrophobicity related more to the composition of SOM.

Keywords: *Decomposition, organic matter, hydrophobicity, water repellency.*