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Soil Microbial Activity as Affected by the Soil-Water Contact Angles

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Abstract

The amount of soil organic matter is dependent on microbial activity. Soil microbial activity plays a critical role in carbon cycling, nutrient turnover, and the production of trace gases. Decomposition of soil organic matter releases CO_2 into the atmosphere increasing the atmospheric carbon content. The increased atmospheric CO_2 has detrimental impacts on climate change. The measurement of microbial activity provides a strong indication of organic matter decomposition rate in the soil and the release of CO_2 to the atmosphere. It is necessary to protect organic matter from excessive biological decomposition. Although the significance of soil hydrophobic properties has been discussed with respect to water dynamics and distribution, their impacts on Carbon stabilization processes as well as on soil microbial activity are less explored. This study was conducted to identify the effects of soil hydrophobicity as measured by soil-water contact angle on the microbial activity as measured by CO_2 evolution. Surface soil samples (Ultisol) collected from Mapalana area were mixed with ground powder of dried cattle manure (CM), goat manure (GM), *Gliricidia maculata* (GL) and *Casuarina equisetifolia* (CE) leaves in 5% concentration to achieve field application level. To induce slight hydrophobic conditions, another set of samples with 5% organic manure (CM, GM, and GL) mixed with small amount of hydrophobic organic matter (2% CE) were also prepared. Microbial activity was measured by NaOH-CO_2 trapping method whereas the hydrophobicity was measured by sessile drop contact angle method. Both measurements were recorded at intervals of 1, 3, 7, 14 and 30 days. Data were statistically analyzed with regression analysis and analysis of variance at 0.05 probability level. Cumulative CO_2 evolution of all the 5% organic matter and 5% organic matter with 2% CE amended samples showed negative linear correlations with contact angles. The highest CO_2 evolution was observed at the 14th day. The highest CO_2 content showed a negative correlation with initial hydrophobicity of the samples (R^2 = 0.85 for samples with 5% organic matter; 0.98 for samples with 5% organic matter mixed with 2% CE). Both the increasing rate of cumulative CO_2 evolution and the difference between initial and maximum CO_2 evolution rates showed negative logarithmic correlations with hydrophobicity (R^2 = 0.87 and 0.88, respectively). The increasing hydrophobicity reduced the CO_2 evolution possibly due to reduced decomposition of organic matter through low accessibility and moisture availability for the microorganisms. The organic matter induced hydrophobicity diminished the microbial decomposition of organic matter, and these findings could be used in soil carbon stabilization. The diminished decomposition will eventually lower the amount and number of repetitions of organic manure applications in agriculture and also lower the emission of CO_2 to the atmosphere.

Keywords: *Contact Angle, Decomposition, Hydrophobicity, Microbial Activity, Organic matter*

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