

Characterization of organic carbons orienting on the surface of water repellent soils

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Water repellency of soils has been observed in various soil types such as sandy, loamy, clayey, peaty, and volcanic ash soils. Water repellency can have a range of soil hydrological consequences such as reduction of infiltration rates, acceleration of surface runoff and erosion, and occurrence of fingering flow. Therefore, proper managements of the water repellent soils are important for optimizing sustainability and productivity of farming system. In the present study, two water repellent soils were collected from a brown forest soil in Aichi Prefecture and an allophanic volcanic ash soil in Fukushima Prefecture, and the surface orientation of organic carbons on the water repellent soils were characterized by measuring pulse saturation transfer magic angle spinning (PSTMAS) ¹³C nuclear magnetic resonance (NMR) and cross polarization magic angle spinning (CPMAS) ¹³C NMR spectra. In PSTMAS spectra, mobile portions of organic carbons are intensified when comparison is made with CPMAS spectra. This phenomenon was confirmed by measuring PSTMAS and CPMAS spectra for silica particle coated with octadecyl group and its mixture with dimethylsulfoxide. In the PSTMAS spectra of two repellent soil samples, it was clearly shown that the peaks at around 12 and 23 ppm were intensified, indicating that the intensified carbons are highly mobile and located on the most outer surface of the soil particles. Judging from the chemical shift values of the NMR spectra, the intensified carbons were assigned as aliphatic carbon chains, such as $-(CH_2)_nCH_3$. In conclusion, at least a part of aliphatic chain would present on the most outer position of the water repellent soils, and they would prevent wetting and water penetration in the soils.

Keywords: Nuclear magnetic resonance, NMR, Water repellent soils, Surface orientation, soil organic matter, soil organic carbon