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Soil type-depending effect of paddy management: composition and distribution of soil organic matter

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Paddy soil management is assumed to promote soil organic matter accumulation and specifically lignin caused by the resistance of the aromatic lignin structure against biodegradation under anaerobic conditions during inundation of paddy fields. The present study investigates the effect of paddy soil management on soil organic matter composition compared to agricultural soils which are not used for rice production (non-paddy soils). A variety of major soil types, were chosen in Indonesia (Java), including Alisol, Andosol and Vertisol sites (humid tropical climate of Java, Indonesia) and in China Alisol sites (humid subtropical climate, Nanjing). This soils are typically used for rice cultivation and represent a large range of soil properties to be expected in Asian paddy fields. All topsoils were analysed for their soil organic matter composition by solid-state 13C nuclear magnetic resonance spectroscopy and lignin-derived phenols by CuO oxidation method. The soil organic matter composition, revealed by solid-state 13C nuclear magnetic resonance, was similar for the above named different parent soil types (non-paddy soils) and was also not affected by the specific paddy soil management. The contribution of lignin-related carbon groups to total SOM was similar in the investigated paddy and non-paddy soils. A significant proportion of the total aromatic carbon in some paddy and non-paddy soils was attributed to the application of charcoal as a common management practise. The extraction of lignin-derived phenols revealed low VSC (vanillyl, syringyl, cinnamyl) values for all investigated soils, being typical for agricultural soils. An inherent accumulation of lignin-derived phenols due to paddy management was not found. Lignin-derived phenols seem to be soil type-dependent, shown by different VSC concentrations between the parent soil types. The specific paddy management only affects the lignin-derived phenols in Andosol-derived paddy soils which are characterized by significantly higher VSC values compared to their parent soil types. However, the higher organic carbon concentrations in Andosol and Alisol (China)-derived paddy soils compared to their parent soil types, could not be explained by an enrichment of lignin-derived phenols. It seems that site specific incorporation of crop residues and properties of the parent soil types are likely more important for organic carbon contents and soil organic matter composition than the effect of paddy management itself.