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Root-derived short-chain suberin diacids from rice and rape seed in a paddy soil under rice cultivar treatments

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Abstract

 Suberin-derived substituted fatty acids have been shown to be potential biomarkers for plant-derived carbon (C) in soils across ecosystems. Analyzing root derived suberin compounds bound in soil could help to understand the root input into a soil organic carbon pool. In this study, bound lipids were extracted and identified in root and topsoil samples. Short-chain suberin diacids were quantified under rice (Oryza sativa L.) and rape (Brassica campestris) rotations with different cultivar combinations in a Chinese rice paddy. After removal of free lipids with sequential extraction, the residual bound lipids were obtained with saponification and derivatization before analysis using gas chromatography-mass spectrometry (GC-MS). Diacids C16 and C18 in bound lipids were detected both in rice and rape root samples, while diacids C20 and C22 were detected only in rape root samples. Accordingly, diacids were quantified in both rhizosphere and bulk soil (0-15 cm). The amount of total root-derived diacids in bulk soil varied in a range of 5.6-9.6 mg/kg across growth stages and crop seasons. After one year-round rice-rape rotation, root-derived suberin diacids were maintained at a level of 7-9 mg/kg in bulk soil; this was higher under a super rice cultivar LY than under a hybrid cultivar IIY. While concentrations of the analyzed diacids were generally higher in rhizosphere than in bulk soil, the total diacid (DA) concentration was higher at the time of rape harvest than at rice harvest, suggesting that rape roots made a major contribution to the preservation of diacids in the paddy. Moreover, the net change in the concentration and the ratios of C16:0 DA to C18:1 DA, and of C16:0 DA to C18:0 DA, over a whole growing season, were greater under LY than under IIY, though there was no difference between cultivars within a single growth stage. Overall, total concentration of root-derived suberin diacids was found to be positively correlated to soil organic carbon concentration both for bulk soil and rhizosphere. However, the turnover and preservation of the root suberin biomolecules with soil property and field conditions deserve further field studies.

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