Does the addition of labile substrate destabilise old soil organic matter?

ID 2722657
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Year 2014
Title Does the addition of labile substrate destabilise old soil organic matter?
Journal Soil biology & biochemistry
Volume 76
Pages / **Article-Number** 149-160
Keywords Priming effect, Triggering, Soil organic matter destabilisation, Stable isotope spectroscopy, PLFA, Biolog test
Input of organic matter to soil may stimulate microbial activity and alter soil carbon storage by modifying the mineralization of native soil organic carbon (SOC). Assessing the age of SOC affected by the altered mineralization is a major challenge as the destabilisation of old SOC would be much more damageable for the overall carbon budget than the mobilization of recent SOC. Here, we investigated the microbial populations sequentially activated after the addition of a labile substrate. We questioned whether they have distinct metabolic potential and we characterised the age of the native SOC they primed. We used soils from Congolese Eucalyptus plantations that were previously under savannah and which old and recent SOC exhibited different delta C-13. Soils were amended with glucose, in an amount sufficient to induce microbe growth, and incubated for one week. The delta C-13 of respired CO2 was continuously recorded using a tuneable diode laser spectrometer (TDLS). The combination of two glucose treatments with different delta C-13 signatures allowed partitioning the various sources of CO2 over time (recent SOC, old SOC and glucose). This was combined with phospholipids fatty acids (PLFA) analyses and potential metabolic activities measurements after 40 h and seven days of incubation. A peak of glucose mineralization occurred after 17 h of incubation. Before this peak (Stage 1), some specific communities with a strong feeding preference for recent SOC were activated. After the glucose peak (Stage 2), over-mineralization of native SOC occurred for some days. The recent 0 SOC was first preferentially used (Stage 3), while the old C4 SOC was destabilised in a later stage (Stage 4). Metabolic functions and composition of microbial communities also differed between Stages 3 and 4.Microbial populations collected at Stage 4 were slower compared to Stage 3, but more efficient in decomposing nutrient-containing substrates. Gram negative bacteria (16:1w7c and 18:1w7c) were stimulated at Stage 3 only, while Gram negative bacteria (cy17:0) were stimulated at both Stages 3 and 4. Our results demonstrated that the input of labile substrate alters the microbial community composition, potential metabolic activities, and the SOC pools utilisation. They pointed out the necessity to assess the age of destabilised SOC when investigating the impact of priming on carbon storage in soil. (C) 2014 Elsevier Ltd. All rights reserved.

Publisher Pergamon Press
ISSN/ISBN 0038-0717
edoc-URL http://edoc.unibas.ch/dok/A6308439
Full Text on edoc No;
Digital Object Identifier DOI 10.1016/j.soilbio.2014.04.030

ISI-Number WOS:000339695900019
Document type (ISI) Article