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ORIGINAL PAPER

# Simulated leaf litter addition causes opposite priming effects on natural forest and plantation soils

Maokui Lyu[1] · Jinsheng Xie[1,2] · Matthew A. Vadeboncoeur[3] · Minhuang Wang[1] · Xi Qiu[1] · Yinbang Ren[1] · Miaohua Jiang[4] · Yusheng Yang[1,2] · Yakov Kuzyakov[1,5,6,7]

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## Abstract

The conversion of natural forests to tree plantations alters the quality and decreases the quantity of litter inputs into the soil, but how the alteration of litter inputs affect soil organic matter (SOM) decomposition remain unclear. We examined SOM decomposition by adding $^{13}C$-labeled leaf-litter of Chinese fir (*Cunninghamia lanceolata* (Lamb.) Hook) to soils from a natural evergreen broad-leaved forest and an adjacent Chinese fir plantation converted from a natural evergreen broad-leaved forest 42 years ago. Over 195 days, we monitored $CO_2$ efflux and its $\delta^{13}C$, microbial biomass, and the composition of microbial groups by phospholipid fatty acids (PLFAs). To distinguish priming mechanisms, partitioning of C sources in $CO_2$ and microbial biomass was determined based on $\delta^{13}C$. Leaf-litter addition to natural forest increased microbial biomass and induced up to 14% faster SOM decomposition (positive priming) than that in soil without litter. In contrast, negative priming in soils under plantation indicated preferential use of added leaf-litter rather than recalcitrant SOM. This preferential use of leaf-litter was supported by an increased fungal to bacterial ratio and litter-derived ($^{13}C$) microbial biomass, reflecting increased substrate recalcitrance, the respective changes in microbial substrate utilization and increased C use efficiency. The magnitude and direction of priming effects depend on microbial preferential utilization of new litter or SOM. Concluding, the impact of coniferous leaf-litter inputs on the SOM priming is divergent in natural evergreen broad-leaved forests and plantations, an important consideration in understanding long-term C dynamics and cycling in natural and plantation forest ecosystems.

**Keywords** Microbial community composition · Priming effects · Selective decomposition · Subtropical forest soils · Land-use effects

## Introduction

Identifying land-use and management practices that maintain and increase soil carbon (C) storage is important for C removal from the atmosphere and improving ecosystem services (Herrero et al. 2016). There is debate about the amount and duration of additional C that can be stored annually in soil following changes in land use or management (Smith 2014).

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✉ Maokui Lyu

✉ Jinsheng Xie
jshxie@163.com

✉ Yusheng Yang
geoyys@fjnu.edu.cn

[1] Key Laboratory for Subtropical Mountain Ecology (Ministry of Science and Technology and Fujian Province Funded), College of Geographical Science, Fujian Normal University, Fuzhou 350007, China

[2] Institute of Geography Sciences, Fujian Normal University, Fuzhou 350007, China

[3] Earth Systems Research Center, University of New Hampshire, 8 College Road, Durham, NH 03824, USA

[4] Department of Geography, Minjiang University, Fuzhou 350108, China

[5] Institute of Environmental Sciences, Kazan Federal University, 420049 Kazan, Russia

[6] Soil Science Consulting, 37077 Göttingen, Germany

[7] Agro-Technology Institute, RUDN University, Moscow, Russia