

Microbial ecology associated to soil-plant interactions: exemplifying recent progress in East Asia

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Received: 30 March 2015 / Accepted: 13 May 2015 / Published online: 21 May 2015
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Microorganisms play crucial roles in interactions between plants and soil (Kennedy and Smith 1995). Soil microbial diversity and functionality are important regulating factors in biogeochemical cycling of elements (such as carbon, nitrogen and phosphorus) and contribute to ecosystem stability and environmental quality. Methodological advances, including the application of molecular and isotope labeling technologies, have led to rapid development of microbial ecology in general and plant-soil interactions in particular (Radajewski et al. 2000). East Asian countries, including China, Japan, and Korea, are in urgent need for solutions regarding food provision and maintaining ecosystem services. In 2003, the ecological societies of these three countries, collaboratively established a federation; the East Asian Federation of Ecological Societies (EAFES), to promote collaboration in ecological and environmental sciences within East Asia. Within the framework of this collaboration an annual conference (EAFES congress) is organized by one of the three Ecological Societies. The

6th EAFES congress was held in Haikou, China, and one symposium of microbial ecology was organized by Prof. Yongguan Zhu and Prof. Huaiying Yao from the Institute of Urban Environment (China), Prof. Hiroyuki Ohta from Ibaraki University (Japan), and Prof. Hojeong Kang from Yonsei University (Korea). East Asian countries are emerging as an increasingly important region contributing to microbial ecology research. The ongoing studies are already generating significant advances in our understanding of microbe-mediated ecological processes in relation to soil-plant interactions, including nutrient cycling, microbial utilization of rhizodeposition, and co-evolution of plants and rhizosphere microorganisms. The symposium led to a proposal to showcase microbial ecology research performed in East Asia in relation to soil-plant interactions through a thematic issue of *Plant and Soil*.

Abstracts for potential papers were invited from the symposium presentations and posters, from which 19 full papers were invited. The papers subsequently accepted for publication include a review and three research articles. The review paper focused on the application of stable isotope labelling of phospholipid fatty acids (SIP-PLFA) to trace C fluxes in soil-plant ecosystems (Yao et al. 2015). It concluded that the SIP-PLFA method provides an excellent tool to study the incorporation of rhizodeposited C into soil microbial biomass and understand the plant-microbe-soil interactions in the rhizosphere. The three research articles used labeling techniques to assess the flow of C photosynthetates in paddy soils and focused on molecular biological techniques to determine the microbial community

Responsible Editor: Paul Bodelier.

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changes in response to biological invasion, elevated CO₂ and temperature. Ge et al. (2015) demonstrated that nitrogen fertilization can promote the incorporation of photosynthesis derived C into soil organic C pools. Overall, the amount of ¹⁴CO₂ that was converted into SOC was proportional to the soil N concentration, indicating that N fertilization promoted rhizodeposition. However, the proportion of ¹⁴C in the microbial biomass C was highest at the lower fertilization rate. Higher microbial activity was found in areas invaded by *Phragmites australis* compared to areas dominated by native species, and plant diversity was found to be the most important regulator of microbial community structure and diversity in these areas (Song et al. 2015). Ren et al. (2015) found distinct response patterns of soil and leaf-associated bacterial communities to elevated CO₂ and temperature. In this study it was observed that the dominance of *Enterobacteriaceae* in leaf tissue may be of great importance in rice growth. These papers highlight the current focus of understanding the interactions between crop plants and microbial communities with respect to nutrient cycling. Future research is likely to increasingly focus on problems affecting food security. Over fertilization, pesticide and industrial pollution are major concerns in many parts of East Asia, in addition to understanding the long-term consequences of climate change.

We would like to thank all the authors who attended the symposium, and contributed abstracts and full manuscripts for their active responses, encouragement and cooperation. Thanks are also due to all the reviewers and to Professor Hans Lambers, the Editor-in-chief and his editorial team at Plant and Soil for handling these papers.

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