frontiers | Frontiers in Forests and Global Change

TYPE Editorial
PUBLISHED 23 May 2024
DOI 10.3389/ffgc.2024.1424150

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OPEN ACCESS

EDITED AND REVIEWED BY
Pedro Giovâni Da Silva,
Federal University of Minas Gerais, Brazil

*CORRESPONDENCE
Jiacun Gu
✉ gjcnefu@163.com

RECEIVED 27 April 2024
ACCEPTED 13 May 2024
PUBLISHED 23 May 2024

CITATION
Gu J, Kou L and Ostonen I (2024) Editorial: Root functional traits in the context of forest ecology and management.
Front. For. Glob. Change 7:1424150.
doi: 10.3389/ffgc.2024.1424150

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Editorial: Root functional traits in the context of forest ecology and management

Jiacun Gu[1]*, Liang Kou[2] and Ivika Ostonen[3]

[1]Key Laboratory of Sustainable Forest Ecosystem Management-Ministry of Education, School of Forestry, Northeast Forestry University, Harbin, China, [2]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (CAS), Beijing, China, [3]Institute of Ecology and Earth Sciences, University of Tartu, Tartu, Estonia

KEYWORDS

root functional trait, root hair, root carbon stock, fine root, coarse root, climate change, urban forest, African montane forest

Editorial on the Research Topic
Root functional traits in the context of forest ecology and management

Roots, the hidden half of plants, are vital for individual survival and ecosystem function. The root system of woody plants can be categorized into fine and coarse roots, based on their diameter. Functionally, fine roots and their mycorrhizal partners are critical for resource uptake, while coarse roots are responsible for anchoring and storage. In the last decade, researchers have turned more to functional approach about separating the absorptive fine roots (e.g., the first two or three orders of branches) from the transport fine roots (the fourth to fifth orders, even down to roots with a diameter < 2 mm), by highlighting the functional heterogeneity within the fine root guild. To better understand the ecological strategy of plants and their response to environmental change, root functional traits, especially for absorptive fine roots are extensively examined, and provide cutting-edge knowledge of belowground ecology. For example, the root economic spectrum is shown to be multidimensional and root economic spaces consisting of "cooperation" and "conservation" gradients are identified for different plant species and growth forms, which undoubtedly provide a unique belowground perspective on forest structure and function and on forestry applications. However, both fine and coarse roots play multiple roles in both natural and artificial systems, so a deep understanding can only be achieved by studying more root traits themselves, in addition to their impacts and responses to environmental conditions at the local and global levels.

The four studies in this Research Topic advance our understanding of the role of fine and coarse roots in the context of forest ecology and management, from the individual to the global scale, by examining the traits from tiny root hairs to root carbon (C) stocks. A paper by Zhou et al. investigated the variations in root hair length, diameter, and density associated with soil and climatic factors, in addition to their relations with life form and genome size. Their results suggest that the root hairs of woody plants are longer, thicker, and denser than those of herbaceous ones and that the responses of root hair traits to soil and climatic conditions also vary with life form, providing a deeper understanding of the role of root hairs in plant resource acquisition and regulation mechanisms. The authors also argued that more specific studies on root hairs should be conducted in the field and across multiple time scales.

As we know, root hairs have a high turnover rate (shorter lifespan), as do the fine roots. Thus, fine roots play a crucial role in belowground C storage and cycling; however, less is known in African montane forests, which cover ∼16% of the world's total area. Yaffar et al. proposed their perspectives on African montane forest, suggesting that fine and coarse root biomass needs to be fully assessed across diverse species and environments by using a standardized trait measurement protocol, which could provide a fundamental basis for better understanding the contribution of African tropical montane forests to the global C budget.

Global change, including drought, is receiving increasing attention. Biological invasion is a global issue that may become more complex in the context of global change, increasing the risk for forest conservation and management. Di Iorio et al. investigated the response of seedlings of the native oak species *Quercus robur* and the alien species *Q. rubra* to water limitation. They found that roots with a diameter of 0.5–1 mm in alien *Q. rubra* seedlings exhibited a stronger response to drought, together with aboveground physiological measurements, demonstrating their isohydric behavior. This alien oak species may have greater competitive potential in drier conditions during the summer and should receive more attention from the administrative departments.

Despite numerous studies focusing on root functional traits in woody plants, little research has been conducted on urban forests. Fantozzi et al. conducted a systematic literature review of fine and coarse root studies with an emphasis on functional traits, in both natural and artificial forests. The study raises several key issues such as the lower diversity of species studied, the uneven selection of functional traits, and a lack of crucial information on experimental designs, particularly less research in urban forest ecosystems. Considering these shortcomings in the experimental setup, applying more cutting-edge technique such as AI tools could shed light on the monitoring, managing and planning for urban forests.

The studies in our Research Topic highlight that fine and coarse root functional traits play multiple vital roles in plant growth and interactions, ecological functions, and social services in natural and urban forests.

Author contributions

JG: Writing – original draft, Writing – review & editing. IO: Writing – review & editing. LK: Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. JG and LK were supported by the National Natural Science Foundation of China (Nos. 32071749 and 32071557). IO was supported by Estonian Research Council Grant PRG916.

Acknowledgments

We thank all the authors and reviewers who helped to improve the submitted papers. We are grateful to the always helpful Frontiers team whose organizational skills and understanding made this Research Topic possible.

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