2023_49_DoLS_Bidartondo: Understanding mycorrhizal associations to ensure the best start in life for trees, their carbon balance and future resilience

Supervisors: Prof Martin Bidartondo (mailto:m.bidartondo@imperial.ac.uk); Dr Elena Vangelova, Forest Research; Dr Laura Suz, Royal Botanic Gardens, Kew.

Department: Department of Life Sciences

A well-functioning forest ecosystem is an amalgamation of climatic and soil factors, with biodiversity at the canopy, understory and soil levels. The resilience and adaptive capacity of a forest is greatly enhanced by high biodiversity and compatibility with soil conditions. This increases the likelihood of future stability despite the uncertainty introduced by climate change. Much needed successful expansion of forest cover in the UK must be based on an understanding of a number of constraints, so the pathways to sustainable and resilient new planting of trees ensure that biodiversity, carbon storage and functional targets are achieved. Our strategy is based on building resilient trees from the ground up by understanding and exploring the links between belowground soil and root health and aboveground tree health.

Ectomycorrhizal trees do not interact directly with soil, instead their belowground interactions with nutrients, carbon, water and microbes are mediated through fungal tissue. To understand how trees interact with soils, we must understand their mycorrhizas. Trees allocate up to 20% of their carbon to mycorrhizal fungi and in return these fungi provide nearly all macronutrients, micronutrients and water needed by their tree hosts. (Smith & Read, 2008 Mycorrhizal Symbiosis 3rd ed). Recent evidence shows strong European-scale links among ectomycorrhizal diversity, tree growth, tree nutritional status, N deposition and soil C cycling, allowing the identification of clear environmental thresholds and indicators (van der Linde et al., 2018 Nature; Suz et al., 2021 New Phytologist; Anthony et al., 2022 ISME J.). How this emerging understanding translates to local and fine-resolution scales for tree health, particularly in UK settings, and in reference to tree establishment and future tree resilience needs investigation.

This project will study links between mycorrhizal associations of the main British tree species and mixtures to their growth, carbon balance, health and resilience from the onset of tree establishment. This project will link belowground soil carbon and health with aboveground forest carbon and health for a set of tree species and soil types using a subset of the 1,500 Woodland Carbon Code project sites. This is linked to an England Tree Planting Programme's Forest Research project assessing soil carbon change at Woodland Carbon Project Sites.

This project aims to: 1. assess the mycorrhizal fungi of different tree species and mixtures in their first 20 years of growth, 2. compare mycorrhizal fungal communities as well as their functional exploration types for the same tree species growing on different soil types (ranging from nutrient-poor to nutrient-rich), 3. compare mycorrhizal fungi and functional exploration types for different tree species growing on the same soil type, and 4. test relationships between mycorrhizal associations with measured soil and tree health traits.

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