

# Combining ectomycorrhizal fungi and bacteria: a powerful tool to improve tree performance

Miguel A. Ramos, Nadine R. Sousa, Albina R. Franco, Gonul Dundar, Rui S. Oliveira,  
Paula M.L. Castro\*

CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino Almeida, 4200-072 Porto, Portugal

**email:** \*Paula M.L. Castro, [plcastro@porto.ucp.pt](mailto:plcastro@porto.ucp.pt)

Ectomycorrhizal fungi are ubiquitous to forest soils and the symbiosis between these microorganisms and plants roots is known to be essential for tree establishment and development, especially in areas of poor soil. Studies have also shown that some rhizosphere bacteria may act as plant stimulating agents and growth promoters. Additionally, bacteria and fungi strongly interact and therefore the analysis of the triangle plant-fungi-bacteria is a vital approach when aiming at the use of microbial inocula to enhance plant performance. To obtain a synergistic combination between microorganisms, a thorough selection is required since bacteria may strongly inhibit fungal growth, and vice versa, incurring in the risk of failed inoculum. In the present work we investigated the use of a dual inoculation system, consisting of a bacterial strain from the genus *Mesorhizobium* in combination with selected ectomycorrhizal fungi. *In vitro* tests were performed to assess the dynamic of co-culturing both microorganisms. The inoculum was applied at nursery stage and saplings were then transplanted into the field. Approximately 5000 seedlings were used in this experiment comprising the following species: *Quercus suber*, *Quercus robur*, *Quercus rubra*, *Pinus pinaster* and *Pinus pinea*. Seedlings were grown for 9 months in a commercial forest greenhouse and then transplanted to 4 locations in Portugal: Mindelo, Santo Tirso, Vila do Conde and Proença-a-Nova. Samples were taken at the end of nursery phase and 8 months after transplantation. Biometric and mycorrhizal parameters were analyzed and the persistence of the inoculated strains was evaluated. The presence of selected phytohormones was also determined. Results showed that the combined use of fungi-bacteria inoculum can be more effective than the use of each individual microbial partner. The use of ectomycorrhizal fungi and bacteria has great potential in forestry as a biotechnological tool to produce high performance plants at nursery stage and in the field.

Acknowledgements: This work was supported by FCT Project PTDC-AGR-CFL-111583-2009 and PEst-OE/EQB/LA0016/2011. The authors acknowledge Fundação para a Ciência e a Tecnologia and Fundo Social Europeu (III Quadro Comunitário de apoio) for the research grants of Nadine R. Sousa (SFRH/BPD/89112/2012), Albina R. Franco (SFRH/BD/47722/2008) and Rui S. Oliveira (SFRH/BPD/85008/2012).