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Analysis of mycorrhizal colonisation of Scots pine roots by electrical impedance spectroscopy

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Introduction

There are no non-destructive methods for measuring mycorrhizal colonization of plant roots. We studied if colonization by symbiotic mycorrhizal fungi would affect electrical impedance spectra (EIS) of Scots pine (*Pinus sylvestris* L.) roots in non-destructive measurements.

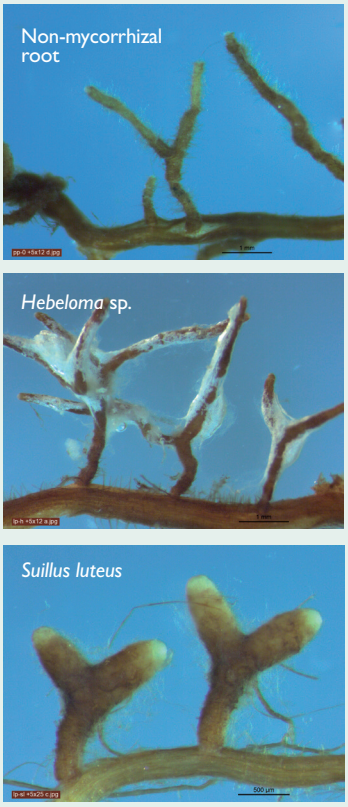
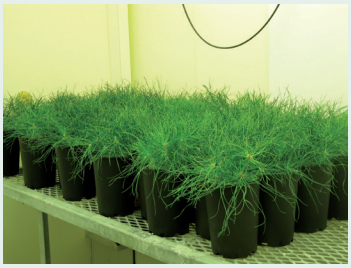


Fig. 1. Examples of non-mycorrhizal and mycorrhizal roots (up) of the pine seedlings (below).



Material and methods

- The seedlings were raised in growth room conditions. The roots were inoculated with mycorrhizal fungus *Hebeloma* sp. (H) or with *Suillus luteus* (SL) or left as non-mycorrhizal control (O) (Fig. 1).
- EIS of the root systems were measured after 19 weeks with a three-electrode measuring setup (Fig. 2).
- Normalized EIS were analysed by a classification method using CLAFIC algorithm that employs principal component analysis (PCA).

Results

- There was no difference between the treatments in the original or normalized data (Fig. 3).
- In the CLAFIC-analysis, O and H treatments could be classified correctly at the dimension >10 and SL treatment at the dimension >15 (Fig. 4).

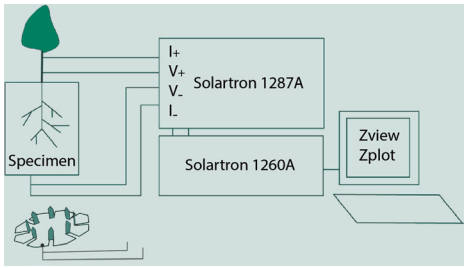


Fig. 2. Experimental set-up to measure electrical impedance spectrum of the root system.

Conclusions

The seedlings by fungal treatments could be classified according to the current delivery through the root system electrolytes sensed by EIS. Current flow is more dispersive through SL than H or non-mycorrhizal roots. This may be related to ion concentration and other physicochemical properties of roots and root-soil interface.

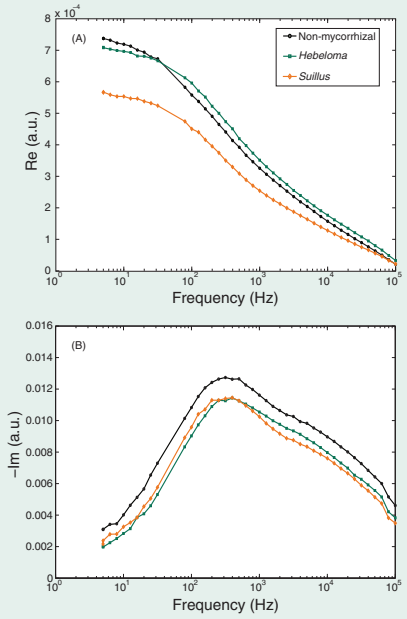


Fig. 3. The normalized real (A) and imaginary (B) part of roots by mycorrhizal treatments (mean of 24 spectra)

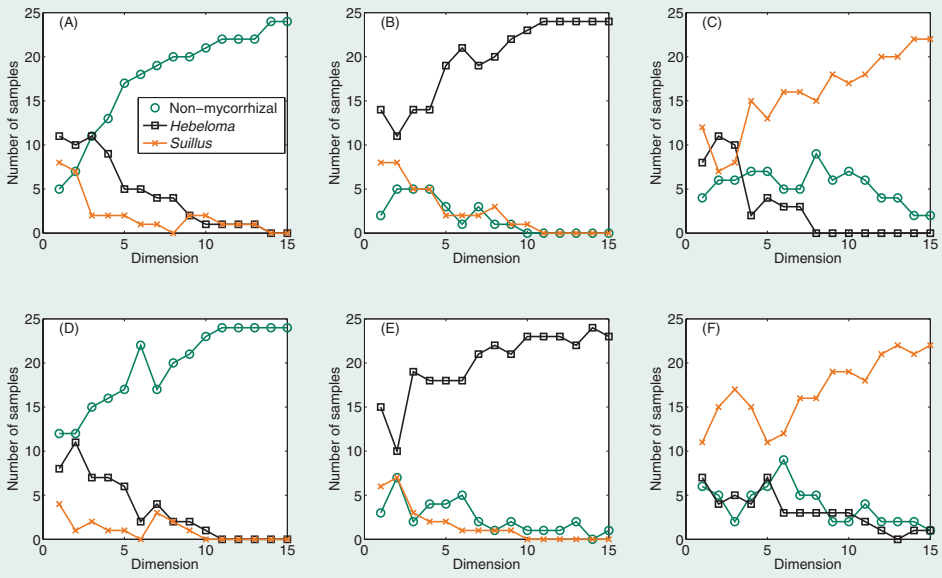


Fig. 4. Classification of the real (A-C) and imaginary (D-F) part of EIS of roots by mycorrhizal treatments in three-class problem. Total number of spectra n=142.

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