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Small-scale soil water repellency in pine rizhosphere associated with ectomycorrhiza is affected by nutrient patchiness: a soil microcosms study

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Soil water repellency (SWR) or hydrophobicity has been commonly related to organic compounds released from the roots or decomposition of different plant species (Doerr et al., 2000). In addition, fungi and microorganisms that are associated with specific plants, could also influence SWR through the production of exudates or cellular material that form hydrophobic coatings on soil surfaces (Feeney et al., 2004; Hallett and Young, 1999) or act as surfactants. Nutrient availability, microbial biomass, organic matter and specific exudates have all been associated with the development of SWR. In terms of plant productivity, these impacts can be significant as their interaction with pore structure changes at the root-soil interface regulates both water transport and storage (Sperry et al., 1998).

In boreal forests, *basidiomycetous* fungi are known to have a large impact on the development of SWR. These fungi are important degraders of organic material and symbionts forming ectomycorrhizal fungi (EF) associations with trees. Although many researchers have suggested a strong positive impact of EF on the ability of plants to capture water from soils, their impact on SWR at the root-soil interface and spatially within soil with a patchy nutrient distribution has not yet been investigated. This study used microcosms with mycelia systems of the EF extending from *Pinus sylvestris* host plants. Each microcosm was incubated during 15 days and contained plastic cup with ^{33}P under the roots. The transfer of P from the mycelium to the host plant was monitored using a radioactive tracers and a non-destructive electronic autoradiography system in another study (data not published). SWR was measured using different approaches; as repellency index, R using a microinfiltrometer with a contact radius of 0.1 mm (modified from Hallet et al., 2002) and with the water drop penetration time test (WDPT). Sorptivity and SWR were measured between 40-50 points/microcosms. Results obtained with both approaches were correlated (Spearmans' rho correlation coefficient = 0.698*). Most of the points measured along the microcosms showed hydrophobicity. Preliminary results indicate that the presence/absence in each point of visual roots along the microcosms was not related with a higher hydrophobicity ($P>0.05$). However, the distance from each point to the cups of ^{33}P was significant ($P<0.05$), the highest water repellency persistence closest points to the cups. Significant correlations between distance (mm) and SWR results were also found in the four microcosms. These results suggest that there is not a direct relationship between the presence of the roots and an increase of hydrophobicity when EF are present.. However, hydrophobicity increases when the nutrient availability is higher, near to the ^{33}P cups. Both an increase in the mycelia around the cups and an increase in the enzymatic activity to process the organic material might be responsible for the higher hydrophobicity found.

References:

Doerr, S.H., Shakesby, R.A.,Walsh, R.P.D. 2000. Soil water repellency: its causes, characteristics and hydrogeomorphological significance. Earth-Science Reviews 51, 33–65.

Feeney, D.S., Daniell, T., Hallett, P.D., Illian, J., Ritz, K., Young, I.M. 2004. Does the presence of glomalin relate to reduced water infiltration through hydrophobicity? Canadian Journal of Soil Science 84, 365–372.

Hallett, P.D., Gordon, D.C., and Bengough, A.G. 2003. Plant in?uence on rhizosphere hydraulic properties: direct measurements using a miniaturized in?ltrometer. New Phytologyst 157, 597–603.

Hallett, P.D., Young, I.M. 1999. Changes to water repellence of soil aggregates caused by substrate-induced microbial activity. European Journal of Soil Science 50, 35–40.

Sperry, J.S., Adler, F.R., Campbell, G.S., Comstock, J.P. 1998. Limitation of plant water use by rhizosphere and xylem conductance: results from a model. Plant, Cell and Environment 21: 347–359.