# Proteome adaptations under contrasting soil phosphate regimes of Rhizophagus irregularis engaged in a common mycorrhizal network

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For many plants, their symbiosis with arbuscular mycorrhizal fungi plays a key role in the acquisition of mineral nutrients such as inorganic phosphate (Pi), in exchange for assimilated carbon. To study gene regulation and function in the symbiotic partners, we and others have used compartmented microcosms in which the extra-radical mycelium (ERM), responsible for mineral nutrient supply for the plants, was separated by fine nylon nets from the associated host roots and could be harvested and analysed in isolation. Here, we used such a model system to perform a quantitative comparative protein profiling of the ERM of Rhizophagus irregularis BEG75, forming a common mycorrhizal network (CMN) between poplar and sorghum roots under a long-term high- or low-Pi fertilization regime. Proteins were extracted from the ERM and analysed by liquid chromatography-tandem mass spectrometry. This workflow identified a total of 1301 proteins, among which 162 displayed a differential amount during Pi limitation, as monitored by spectral counting. Higher abundances were recorded for proteins involved in the mobilization of external Pi, such as secreted acid phosphatase, 3',5'-bisphosphate nucleotidase, and calcium-dependent phosphotriesterase. This was also the case for intracellular phospholipase and lysophospholipases that are involved in the initial degradation of phospholipids from membrane lipids to mobilize internal Pi. In Pi-deficient conditions. The CMN proteome was especially enriched in proteins assigned to beta-oxidation, glyoxylate shunt and gluconeogenesis, indicating that storage lipids rather than carbohydrates are fuelled in ERM as the carbon source to support hyphal growth and energy requirements. The contrasting pattern of expression of AM-specific fatty acid biosynthetic genes between the two plants suggests that in low Pi conditions, fatty acid provision to the fungal network is mediated by sorghum roots but not by poplar. Loss of enzymes involved in arginine synthesis coupled to the mobilization of proteins involved in the breakdown of nitrogen sources such as intercellular purines and amino acids, support the view that ammonium acquisition by host plants through the mycorrhizal pathway may be reduced under low-Pi conditions. This proteomic study highlights the functioning of a CMN in Pi limiting conditions, and provides new perspectives to study plant nutrient acquisition as mediated by arbuscular mycorrhizal fungi.
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