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Symbiont identity matters: carbon and phosphorus fluxes between Medicago truncatula and different arbuscular mycorrhizal fungi.

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Abstract

Many studies have scrutinized the nutritional benefits of arbuscular mycorrhizal associations to their host plants, while the carbon (C) balance of the symbiosis has often been neglected. Here, we present quantification of both the C costs and the phosphorus (P) uptake benefits of mycorrhizal association between barrel medic (Medicago truncatula) and three arbuscular mycorrhizal fungal species, namely Glomus intraradices, Glomus claroideum, and Gigaspora margarita. Plant growth, P uptake and C allocation were assessed 7 weeks after sowing by comparing inoculated plants with their non-mycorrhizal counterparts, supplemented with different amounts of P. Isotope tracing (^{33}P and ^{13}C) was used to quantify both the mycorrhizal benefits and the costs, respectively. G. intraradices supported greatest plant P acquisition and incurred high C costs, which lead to similar plant growth benefits as inoculation with G. claroideum, which was less efficient in supporting plant P acquisition, but also required less C. G. margarita imposed large C requirement on the host plant and provided negligible P uptake benefits. However, it did not significantly reduce plant growth due to sink strength stimulation of plant photosynthesis. A simple experimental system such as the one established here should allow quantification of mycorrhizal costs and benefits routinely on a large number of experimental units. This is necessary for rapid progress in assessment of C fluxes between the plants and different mycorrhizal fungi or fungal communities, and for understanding the dynamics between mutualism and parasitism in mycorrhizal symbioses.

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