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The modulation of plant nutrition and soil properties by mycorrhizal fungi and their preferences for the soil texture they encounter

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Arbuscular mycorrhizal fungi (AMF) affect both plant nutrition and soil physical properties, including soil water retention and hydraulic conductivity. However, much less is known about the preferences of AMF for proliferation into soils of different (physical) natures, i.e. soil textures. To investigate this, we designed a pot trial with tomato in which AMF had access to root-free soil patches of different textures. We hypothesized that AMF would prefer fine-textured soils over coarse-textured soils because a finer textured soil is comparatively moist (which most fungi prefer) and contains a greater share of low-weight particles (less growth resistance) than a coarse-textured soil.

We inoculated tomato plants with the fungus *Rhizopagus irregularis* grown in 4L pots filled with a quartz sand: loam mixture (1:1 w/w). The loam is a calcareous alluvial loam obtained from the C-horizon with a pH of 7.5, low in organic matter (0.05% C_{org}), 42.72% sand, 44.22% silt, 13.06% clay and is highly P-fixing. The self-propagated fungal inoculum used was based on this loamy soil and, therefore, inoculation did not compromise the soil texture of the potting mix. Each pot received three ingrowth cores covered in root-excluding nylon mesh (37 µm) containing either pure quartz sand (grain size 0.3 – 1.0 mm), pure loam soil or a 1:1 mixture of the two (as in the main pot). To cause variance in soil hyphae development, we applied two treatments. On the one hand, half of the pots contained the tomato cultivar 76R and the other half its related *rmc* mutant, which is known to show reduced mycorrhizal colonization. On the other hand, we subjected half of the pots to two weeks of terminal drought to slow down plant and fungal growth, while the other half of the pots were kept under ample moisture. After harvest, we measured root colonization and plant nutrient uptake to verify the viability of the mycorrhizal symbioses. From the ingrowth cores, we extracted AMF hyphae and determined their length. As traits known to be affected by functional hyphae and plant activity as well as soil desiccation, we also measured aggregate stability indices in soils from the ingrowth cores.

According to our expectations, we found that the 76R tomatoes, which were able to develop a viable symbiosis, had higher tissue P and N mass fractions in their dry matter than the *rmc* tomatoes. Against our expectations, the 76R plants were more sensitive to drought when exposed to it and had significantly lower biomass than the *rmc* plants and the 76R plants maintained under ample moisture. Furthermore, we illustrate our findings on hyphal length density and aggregation and discuss them with regard to the preferences of AMF to populate the soils with different textures. We answer whether our hypothesis must be confirmed or denied and deduce some potential ecological consequences of our findings.