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In situ quantification of plant carbon allocation in a Maize-AMF system

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Plants engage in symbiosis with arbuscular mycorrhizal fungi (AMF) to exchange plant-derived carbon for essential inorganic nutrients, such as nitrogen and phosphorus. In addition, this symbiosis may sequester carbon in root and microbial biomass and improve plant tolerance to abiotic and biotic stresses. The carbon cost of this nutrient exchange likely depends on the AMF strain, and the partitioning of plant-derived carbon to fungal storage organs differs by AMF strain. A better understanding of the fate of carbon within plant-AMF systems will enable the optimization of AMF consortia for carbon sequestration and plant growth. However, quantification of AMF effects on plant carbon allocation is limited, and most methods require destructive sampling. Here, we combine x-ray computed tomography (XCT) and positron emission tomography (PET) to observe and quantify in situ the flow of carbon from leaves to roots to hyphae. Preliminary results in a maize-Rhizophagus irregularis system suggest that R. irregularis induces an increase in carbon allocation to the root system than in uninoculated controls. Comparison of the segmented root systems obtained from XCT images indicates an increase in lateral root growth in inoculated plants. Co-registered XCT and PET images suggest the increase in carbon correlates with increased lateral root development near the inoculation site. Our in situ method for quantifying carbon allocation has deepened our understanding of maize-AMF symbiosis and will enable future studies characterizing how different AMF strains alter carbon partitioning in various land plants.

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Inoculation with selected strains of *Bacillus megaterium* and *B. subtilis*, present in the first inoculant released in Brazil, increases maize phosphorus acquisition and yield

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Phosphate solubilizing microorganisms are the one of the most sustainable and inexpensive alternatives for enhancing phosphorus (P) availability for plants once they can transform insoluble P into soluble forms by different mechanisms. In this work, we analyzed the effect of the inoculation of two bacterial strains (*Bacillus subtilis*_CNPMS B2084 and *B. megaterium*_CNPMS B119), isolated from P-efficient tropical maize genotypes, on maize growth. The two *Bacillus* strains were co-inoculated under controlled conditions and enhanced total root area. The *Bacillus* strains were inoculated separately and co-inoculatedd in maize in two different localities (Sete Lagoas and Goiânia, Brazil) that represent two crop growing regions, in three seasons in a completely randomized block design with four replicates. *Single inoculation* of maize plants with CNPM B119 and B2084 increased grain yield by 14% and 10%, respectively. The co-inoculation of the two strains in maize increased grain P content by 13% and grain yield by 17%. Additionally, soil P-cycling and P availability were significantly higher after the third year of inoculation. These positive results led to the release in 2019 of the first Brazilian commercial P-solubilizing bacteria inoculant.

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