

An Arbuscular Mycorrhizal Fungus Alters the Distribution of Photosynthesized Carbon in a Plant-Soil System: A ^{13}C Labeling Microcosm Study

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Abstract

Background: Quantification of carbon allocation in mycorrhizal plant parts is an important task in mycorrhizal physiology and ecology, especially for arid and semi-arid barren ecosystem. Here, we investigate the effects of arbuscular mycorrhizal fungi (AMF) on the distribution of photosynthetic carbon in different plant parts and the influence factors. A ^{13}C pulse-labeling method was used to investigate the effects of AMF on the carbon absorption and photosynthate distribution in parts of maize, determined the concentrations of P, K and Mg in plant parts and their correlations with AMF and soil physicochemical properties using redundancy analysis.

Results: The total amount of ^{13}C in plants inoculated with AMF was significantly higher than controls. The ^{13}C distribution rates in true leaves 6-7 and 8-12 were higher 26.2% and 41.7% than in the controls indicating that AMF promoted plant fixation of more photosynthetic carbon in plant parts. Soil EEG, HD and SOC were identified as the edaphic factors affecting carbon distribution in different plant part.

Conclusion: The study demonstrates that AMF can lead to elevated photosynthetic carbon sequestration and increased transfer of photosynthetic products to roots and soil compared with non-mycorrhizal maize, provide baseline data for assessing carbon accumulation effects of AMF on semi-arid soil.

Full Text

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Figures

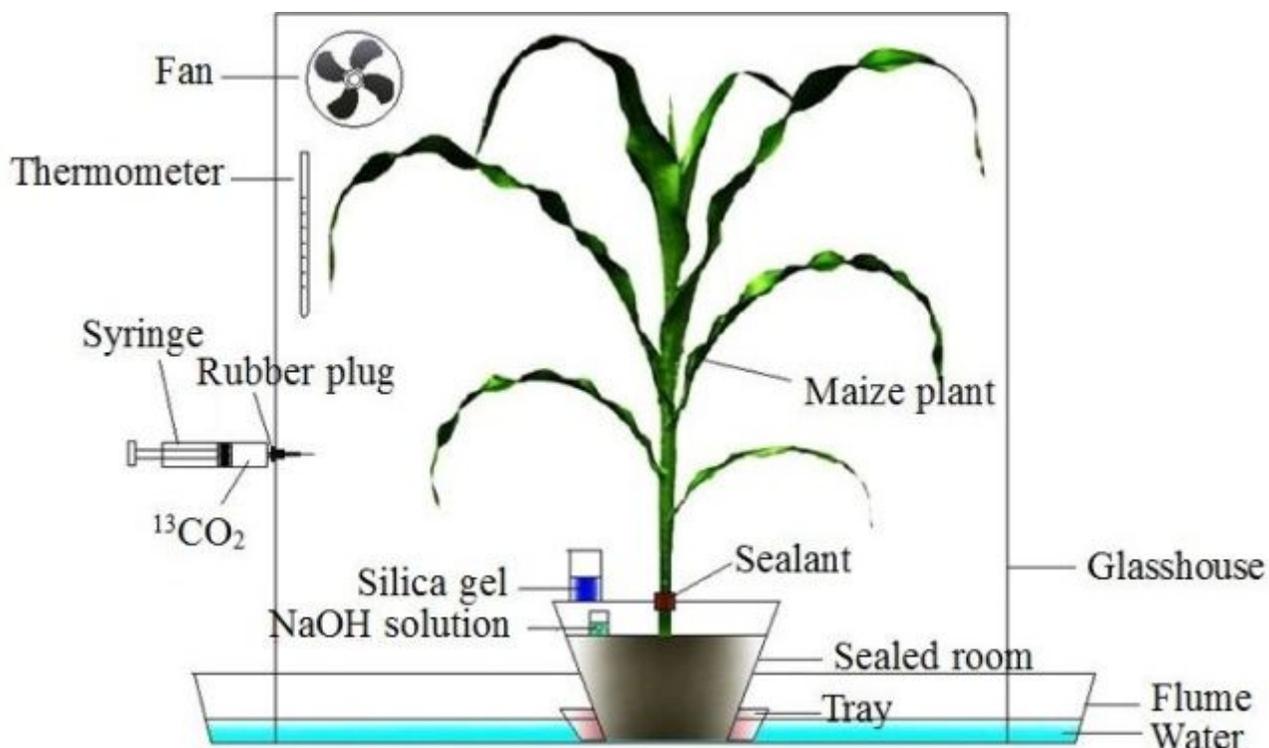


Figure 1

The pulse labeling device.

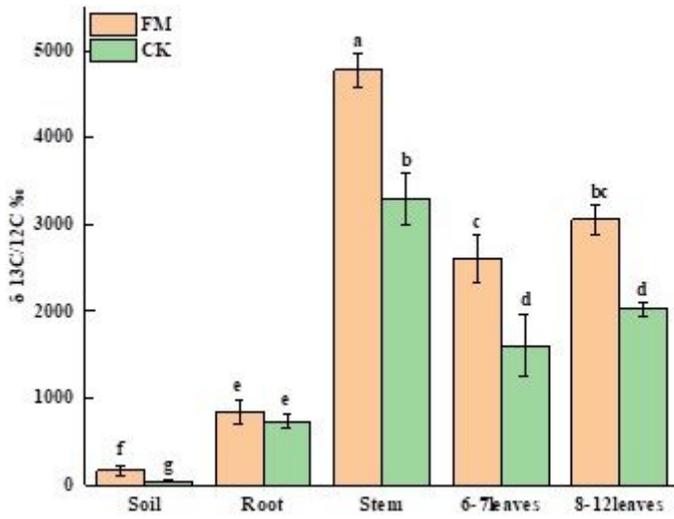


Figure 2

Effects of AM inoculation on the content of ^{13}C in maize parts (%). Data are presented as the mean ($n = 3$) \pm SE. The lowercase letters in indicate significant differences among different treatments ($P < 0.05$). FM, inoculation with *Funneliformis mosseae*; CK, uninoculated control.

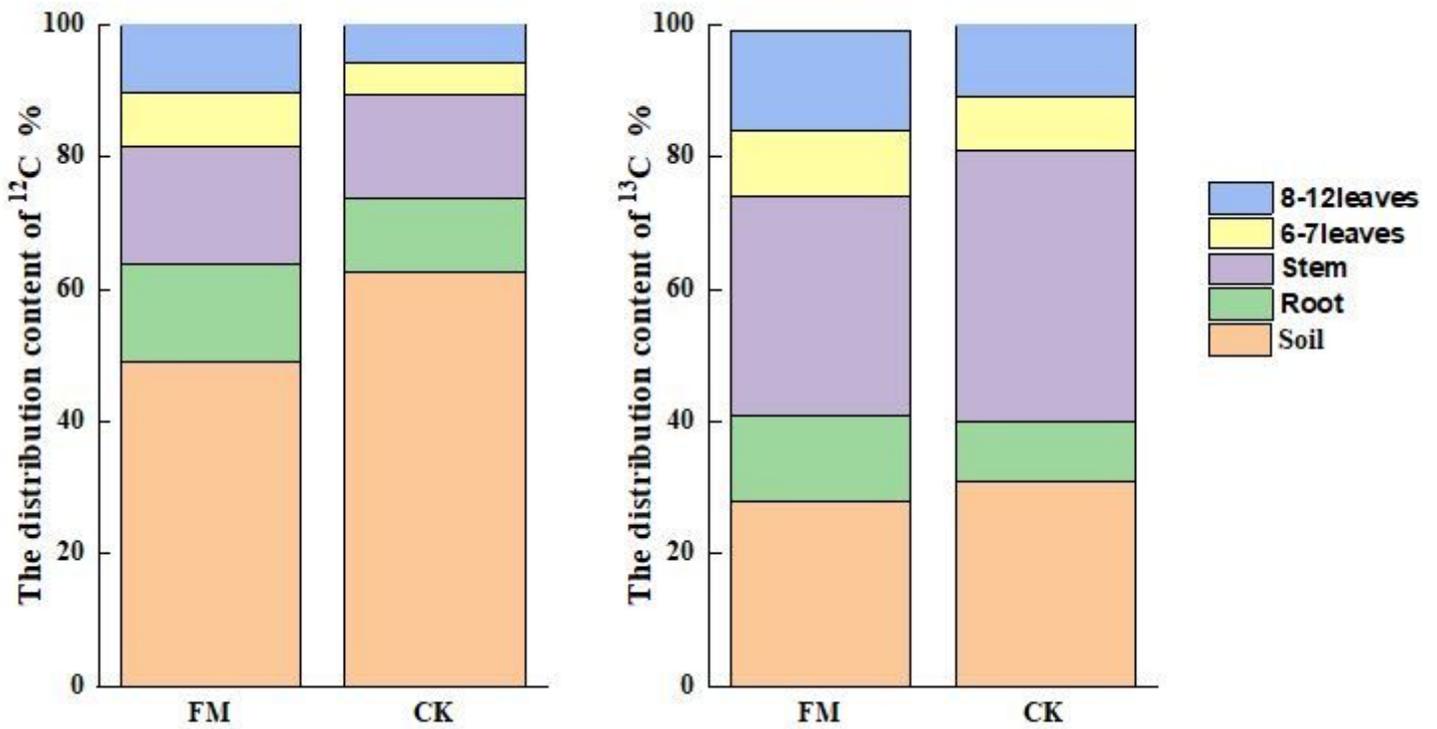


Figure 3

Distribution of ^{12}C and ^{13}C

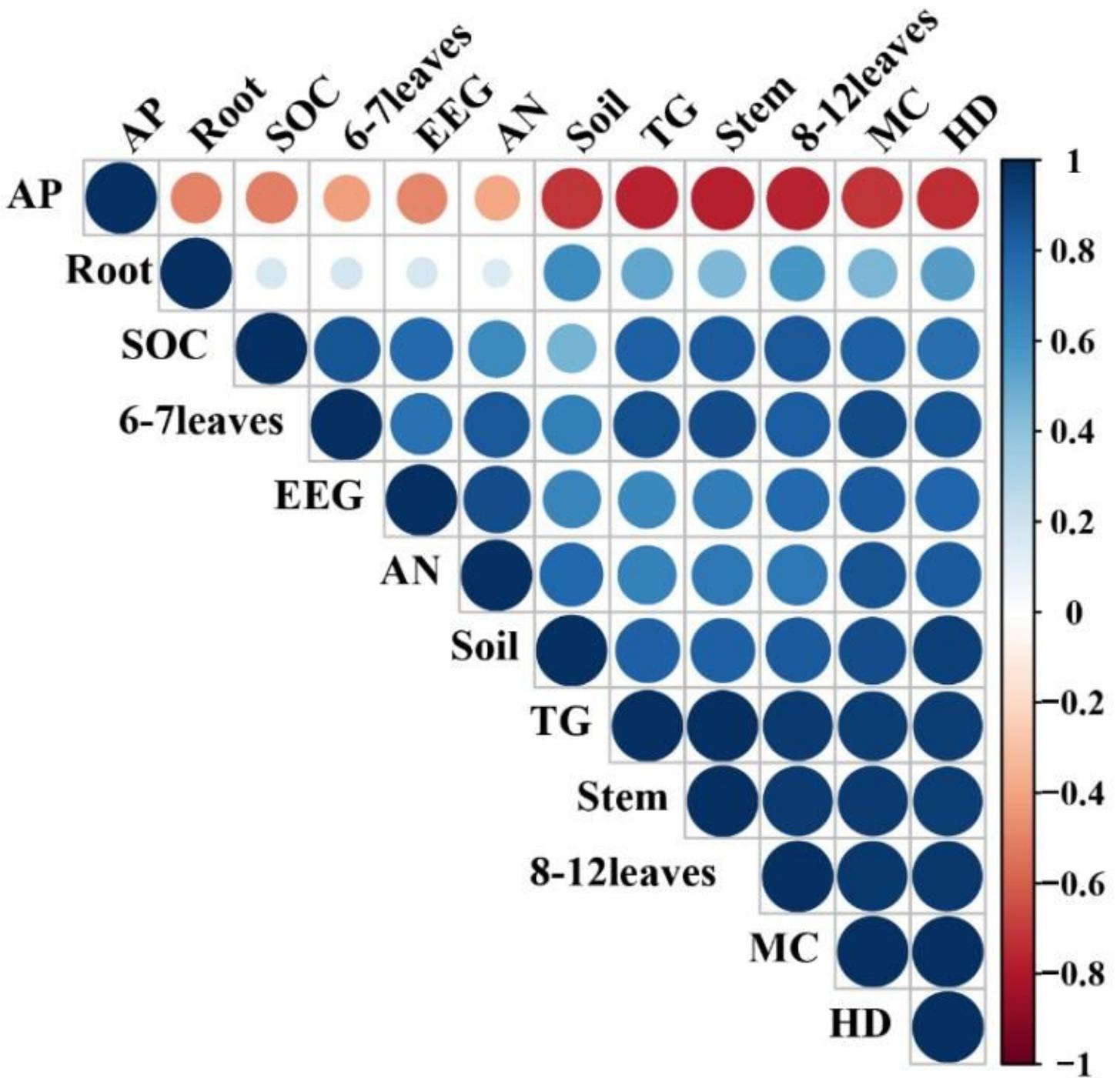


Figure 4

Pearson correlations among carbon distribution in plant parts, AMF and soil properties. MC, mycorrhizal colonization; HD, hyphal density; EE-GRSP, easily extractable glomalin; TG, total glomalin; SOC, soil organic carbon; AN, available nitrogen; AP, available phosphorus.

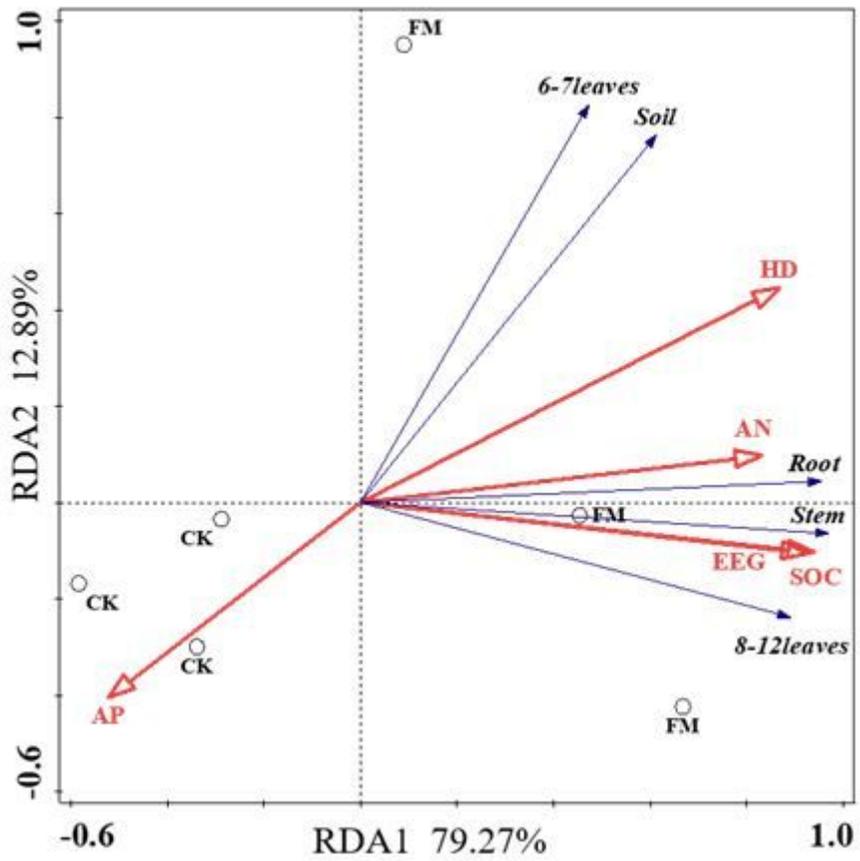


Figure 5

Redundancy analysis among carbon distribution in plant parts, AMF and soil properties