EGU21-13823
https://doi.org/10.5194/egusphere-egu21-13823
EGU General Assembly 2021

Application of arbuscular mycorrhizal fungi alters soil respiration, soil aggregation and total organic carbon in tropical agriculture

Diego Camilo Peña Quemba, Alia Rodriguez, and Ian Sanders
Universidad Nacional de Colombia, Agronomia, Colombia (dcpenaq@gmail.com)

Soil degradation is a major concern worldwide and tropical agriculture is a major contributor to CO_2 release from soils. There is growing interest in stabilizing atmospheric CO_2 abundance to reduce its direct effect on global warming, by focusing on the potential of soil to sequester carbon. Soil structure directly influences soil stability and carbon sequestration. Arbuscular mycorrhizal fungi (AMF) are one of the most important microbial soil components for soil aggregate formation and stabilization through physical and biochemical processes allowing the encapsulation of organic carbon. However, the contribution of AMF to soil aggregation remains to be demonstrated under field and farming conditions and has only been shown in pot experiments with sterilized non-mycorrhizal controls. Large differences in cassava (Manihot esculenta Cranz), yield when inoculated under field conditions with diverse isolates of the AMF species Rhizophagus irregularis, suggests that carbon directed belowground and more importantly carbon sequestered within soil aggregates after harvesting might be driven by differences among AMF inocula. Thus, we evaluated the effect of 11 different isolates of Rhizophagus irregularis on CO_2 emissions to the atmosphere (soil respiration), soil aggregation and the amount of soil organic carbon stored in aggregates in soils under commercial cassava cropping. Soil respiration was measured in situ by infrared gas analyser (IRGA, Li-COR 8100A) means. Soil samples were taken in surface (10 cm) and subsoil (30 cm) were taken to determine water stable aggregates size distribution (6.3, 4, 2, 1 and 0.5 mm), total stable aggregates (TSA) and total organic carbon (TOC) per aggregate size. After just one-year, our results showed that carbon decomposition (as measured by soil respiration), soil aggregation and carbon storage (in soil aggregates) were significantly affected by inoculation with AMF. Soil respiration was strongly and differentially affected by R. irregularisisolates with a difference of up to 78% in CO_2 release from the soil. In surface, we found differences in TSA of up to 20% among inoculation treatments driven principally by an increase up to 6.3% in macroaggregate sizes. In subsoil, the TSA differences were up to 40% between AMF lines and at 2 mm aggregate size differences were up to 9,22% compare with non-inoculated treatment. Interestingly in this experiment, TOC and soil aggregation were not correlated. Although TOC in macroaggregates was significatively different up 44% among AMF treatments. Soil aggregation is a soil property often thought as static. Moreover, changes in soil aggregation as the ones we have shown here had only been reported after long-term experiments (up to 30 years) with low intrusive tillage practices (non- or reduced-tillage). Our results clearly show the enormous potential of using AMF in field conditions as a primary tool to improve ecosystem services and soil health in short periods of time.

Keywords: Soil aggregation, AMF, Cassava, carbon storage, soil respiration