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Climate-smart agriculture: microbiological impacts of plant diversity to soil carbon (C) sequestration.

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Soil organic matter (SOM) is any material produced by living organisms at various stages of decomposition. SOM enhances soil fertility and quality and influences soil's ability to fight against soil-borne diseases. Atmospheric CO₂ sequestration into SOM through improved agricultural management practices has been suggested to be a cost effective way to mitigate climate change.

The build-up of SOM is largely regulated by soil microbial activity. Soil microbes use most plant-derived C and either produce CO₂ or incorporate C into their biomass and after death microbial necromass may contribute to stable SOM. Arbuscular mycorrhizal (AM) fungi are one of the root colonizing soil microbes important in nutrient cycling, plant nutrition, growth and composition and maybe soil aggregation. The benefits of microbes including AM fungi should be thus utilized for climate friendly agriculture by magnifying their benefits via better agricultural management.

Cover crops use is one of the climate friendly agricultural practices. Cover crops if managed right, can provide several benefits e.g. enhanced soil C sequestration, reduced emissions from fertilizer production, weed suppression, better soil moisture retention and microbial activity. Moreover, use of diverse cover crops may favor higher soil biodiversity leading to high SOM content. In this project, plant diversity impacts on soil and root fungal community composition and microbial activity related to soil C sequestration were studied in a field experiment. In addition, special attention was given to AM fungi.

The field experiment was started in May, 2019 in Viikki Research farm, University of Helsinki. The experiment consists of seven treatments comparing four different levels of biodiversity to conventional monoculture treatments and bare fallow. Eight different species of cover crops representing four functional traits were sown under barley: 1) nitrogen (N₂)-fixing + shallow rooting, 2) deep rooting, 3) N₂-fixing + deep rooting and 4) no N₂-fixing and shallow rooting. Barley and cover crop root samples and soil samples were collected from two growing seasons 2019 and 2020. Root samples were analyzed for AM fungal colonization %. Soil samples were analyzed for soil microbial biomass and microbial respiration in different seasons. Preliminary results showed no significant cover crop diversity effect on AM fungal colonization % in barley root in 2019. Soil microbial biomass and soil microbial respiration showed seasonal variations but not significant

cover crop diversity effect. Therefore, fungal communities in soil and root will be examined using Illumina (MiSeq) sequencing targeting the fungal internal transcribed spacer (ITS) region. Soil enzyme activities and carbon use efficiency will be performed to gain insight into microbial activity. Obtained results will show if microbial community and activity is affected by either plant family composition or plant diversity.