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Effect of long-term farming strategies on soil microbiota and soil health

Loreen Sommermann (1), Doreen Babin (2), Martin Sandmann (3), Kornelia Smalla (4), Ingo Schellenberg (5), Rita Grosch (6), and Joerg Geistlinger (7)

(1) Anhalt University of Applied Sciences (AUAS), Bernburg, Germany (Loreen.Sommermann@hs-anhalt.de), (2) Julius Kühn Institute (JKI), Braunschweig, Germany (Doreen.babin@julius-kuehn.de), (3) Leibniz-Institute of Vegetable and Ornamental Crops (IGZ), Großbeeren, Germany (sandmann@igzev.de), (4) Julius Kühn Institute (JKI), Braunschweig, Germany (Kornelia.smalla@julius-kuehn.de), (5) Anhalt University of Applied Sciences (AUAS), Bernburg, Germany (Ingo.Schellenberg@hs-anhalt.de), (6) Leibniz-Institute of Vegetable and Ornamental Crops (IGZ), Großbeeren, Germany (grosch@igzev.de), (7) Anhalt University of Applied Sciences (AUAS), Bernburg, Germany (Joerg.Geistlinger@hs-anhalt.de)

Increasing food and energy demands have resulted in considerable intensification of farming practices, which brought about severe consequences for agricultural soils, e.g. loss of fertility, erosion and enrichment of soil-borne plant diseases. In order to maintain soil quality and health for the future, the development of more extensive and sustainable farming strategies is urgently needed. The soil microbiome is regarded as a key player in soil ecosystem functions, particularly the natural ability of soils to suppress plant pathogens (suppressiveness). Recent studies showed that soil microbial communities are influenced by agricultural management. To further analyze the effects of farming strategies on soil suppressiveness and plant performance, agricultural soils from three long-term field trials in Thyrow, Bernburg (both in Germany) and Therwil (Switzerland) were sampled and subjected to molecular profiling of soil bacteria and fungi using marker genes and high-throughput amplicon sequencing. Significant effects on bacterial as well as fungal community composition, including plant pathogenic and beneficial taxa, were observed among variants of tillage and crop rotation. The least effect on both communities had fertilization, with no significance between variants. Subsequently, the same soils were subjected to growth chamber pot experiments with lettuce as a model (Lactuca sativa). After a growth period of six weeks significant differences in lettuce shoot and soil microbial biomass were observed among soil samples of the different long-term trials. Furthermore, the lettuce rhizosphere exhibited diverse bacterial community compositions as observed by DGGE (denaturing gradient gel electrophoresis). Using group-specific PCR-DGGE fingerprints, bacterial responders to fertilization, soil management and crop rotation were identified among different taxonomic groups. Currently, bacterial and fungal amplicon sequencing of rhizosphere and bulk soil from these pot experiments is ongoing in order to provide further insights into taxa potentially indicative for agricultural management and soil health. Presently, we are testing the potential of the different soil microbiomes to suppress the lettuce pathogen Rhizoctonia solani.