Institute of Environmental Sciences

Topic: plant-microbial interactions

Title: Plant friends and foes under extreme conditions and climatic changes

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Background information:

New challenges are posed by climatic changes, anthropogenic pollution, and agricultural practices affecting soil microbial biodiversity. There is the need to develop alternative technologies to reduce water and fertilizer use and increase plant stress resilience, at the same time feeding growing human population and sustain safety. We offer studies on the multipartite interactions between plants and associating beneficial microbes (endophytic and rhizospheric fungi, bacteria and possibly viruses, offering complementary traits leading to better plant adaptation to dry and polluted soil. The study includes isolation of beneficial microbes, molecular identification, interactions carried out first *in vitro* in presence of microbes and then in pot culture; selection of efficient bio-stimulators attenuating toxicity, alleviating microbial pathogenicity due to direct action and by activating plant defense mechanisms, stimulating production of microbial biofilms on the surface of the roots, exopolysaccharides, surfactants and biominerals.

The main question to be addressed in the project:

The main question is whether it is possible to select consortia of microorganisms so that wheat can be grown with a reduced amount of fertilizers and irrigation, increased resilience to abiotic and biotic factors. Plants associated by biostimulants (endophytic, rhizospheric bacteria and mycorrhizal, endophytic fungi) and using no pesticides and 50% fertilizers should have similar yield as those that were cultivated with high level of fertilizers and pesticides. The microbes will be isolated from extreme habitats what should assure their adaptation to dry and poor soil

Information on the methods/description of work:

The studies will be carried out using conventional and molecular tools including sequencing, gene expression, preparation of fluorescent biomarkers, diverse chemical and microscopical methods including Raman microscopy, cultivation methods depending on the needs. The

main model for studying the interaction will be wheat cultivar that is the main crop in Europe. At the beginning the strains available in the laboratory will be used to understand and to learn the methods used to characterize the objects. Plant vitality accompanied by selected microbes will be evaluated using Handy PEA apparatus or other available techniques.

Additional information (e.g.) Special requirements from the student) **:**
The student should have knowledge and experience in microbiology and molecular biology including work with PCR, RT-PCR, confocal/fluorescent microscopy.

Place/name of potential foreign collaborator: Prof. Erika Kothe (Jena University)

References (3)

Bargaz, Adnane et al. 2018. "Soil Microbial Resources for Improving Fertilizers Efficiency in an Integrated Plant Nutrient Management System." *Frontiers in Microbiology* 9(July).

Bonfante, P, and A Genre. 2010. "Mechanisms Underlying Beneficial Plant-Fungus Interactions in Mycorrhizal Symbiosis." *Nat Commun* 1: 48. http://www.ncbi.nlm.nih.gov/pubmed/20975705.

Venkova, Tatiana et al. 2018. "Belowground Defence Strategies in Plants." *Frontiers in Microbiology* 9(1): 1–14. http://www.ncbi.nlm.nih.gov/pubmed/20013261 (May 20, 2012).