Title: Shaping the bacterial and fungal microbiome in legume-cereal intercropping

ACRONYM: LEGUMINOSE

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The project is interdisciplinary and includes several research fields: agriculture and horticulture, agronomy, microbiology, mycology, biochemistry, molecular biology and bioinformatics.

Current high input agricultural practices, such as intensive application of fertilizers and agrochemicals and long-term monocropping are already resulting in soil degradation and loss of ecosystem services from agroecosystems. **Major forms of this degradation include** soil erosion, soil organic matter loss, increased greenhouse gas emissions, acidification, salinization, aa well as **loss of soil microbial biodiversity**. Therefore, interventions and actions to stop and reverse this unfavorable phenomenon are needed. **Enhancing on-farm diversity via legume-cereal cropping systems**, which support mechanisms for suppressing weeds, controlling pests and diseases, reducing external N demand, conserving soil resources and soil health while increasing crop yield, **has significant potential**.

Legume-cereal systems are the most common intercropping combinations used in sustainable farming models because of their noncompeting niche requirements and the symbiosis ability with N_2 fixing microorganisms. The better quality of cereal produced by intercropping with legumes can also have economic benefits for farmers by increasing the protein content. However, **there is little research on the functional and genetic diversity of soil microorganisms in legume-cereal intercropping.** It is known that soil biota and its activities are of utmost relevance for assuming soil quality as it is a crucial driver for element cycling in soil and its abundance and diversity depend on the availability of food sources. **Due to the complexity of the soil microbiome and plant holobiont, there is great uncertainty about how soil microbial communities are shaped by different crop species, and especially how the bacterial and fungal microbiome is shaped in the legume-cereal intercropping.** Therefore, **the aim of the planned research is to determine the functional and genetic diversity of microorganism communities inhabiting the rhizosphere of plants in legume-cereal intercropping.** Based on agroecology principles, the following **hypotheses** were formulated: **i) the higher plant diversity of intercropping systems will increase soil microbial biodiversity and improve plant health in agroecosystems as compared to cereals grown in pure sowing and/or monoculture; ii) the increasing plant health in intercropping systems is the result of increasing below ground networks between rhizosphere microbial community.**

Only fragmentary information is available in the literature on the shaping soil bacterial and fungal microbiome as well as the functional and genetic biodiversity of soil microorganisms in legume-cereal intercropping, which indicates the need for research in this area. The research will include comprehensive recognition of the microbiota and mycobiota inhabiting the rhizosphere of plants in legume-cereal intercropping and in pure sowing of cereals, using next-generation sequencing and other molecular biology techniques, as well as determining the activity and functional diversity of microorganism communities found in the rhizosphere of these plants.

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