PE&RC call for institutional collaboration

Title: **Extending the plant cry for help paradigm to the micro-food web**

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Focus and aim of the project (max. 250 words)

Plants can recruit soil microbiomes to help them fend off disease. Recently, we have adopted a 'learning from nature' approach to identify bacteria and fungi that can help improve plant resistance to pathogen attack. At the same time, we know that soil protists can exert top-down control on soil microbial communities and functions through predation, thereby playing an important role in modulating plant disease suppression. Our previous work highlighted the crucial role of interkingdom interactions between bacteria and fungi in enhancing plant disease suppression. Here, we will extend the 'cry for help' paradigm to include protists and their trophic interactions with bacteria and fungi (Fig 1). Specifically, based on previous sequencing data, we will first further identify bacterial, fungal and protist populations correlated with enhanced plant disease suppression across banana varieties. Using isolates from our extended strain collections, we will then construct synthetic communities (SynComs) that correspond most closely to the presumptively suppressive microbial assemblages previously identified. We will examine the impact of protists on SynCom performance by determining the suppressive capabilities of our interkingdom SynComs with and without protist inoculation. We will also track SynCom dynamics to assess the responses of bacteria, fungi, and protists to pathogen invasion.

We hypothesize that:

1) The cry for help paradigm can be extended to soil protists: pathogen attack of resistant varieties induces the recruitment of bacteria, fungi and protists that together suppress the pathogen.
2) Inclusion of protists in interkingdom SynComs improves their pathogen suppression abilities.

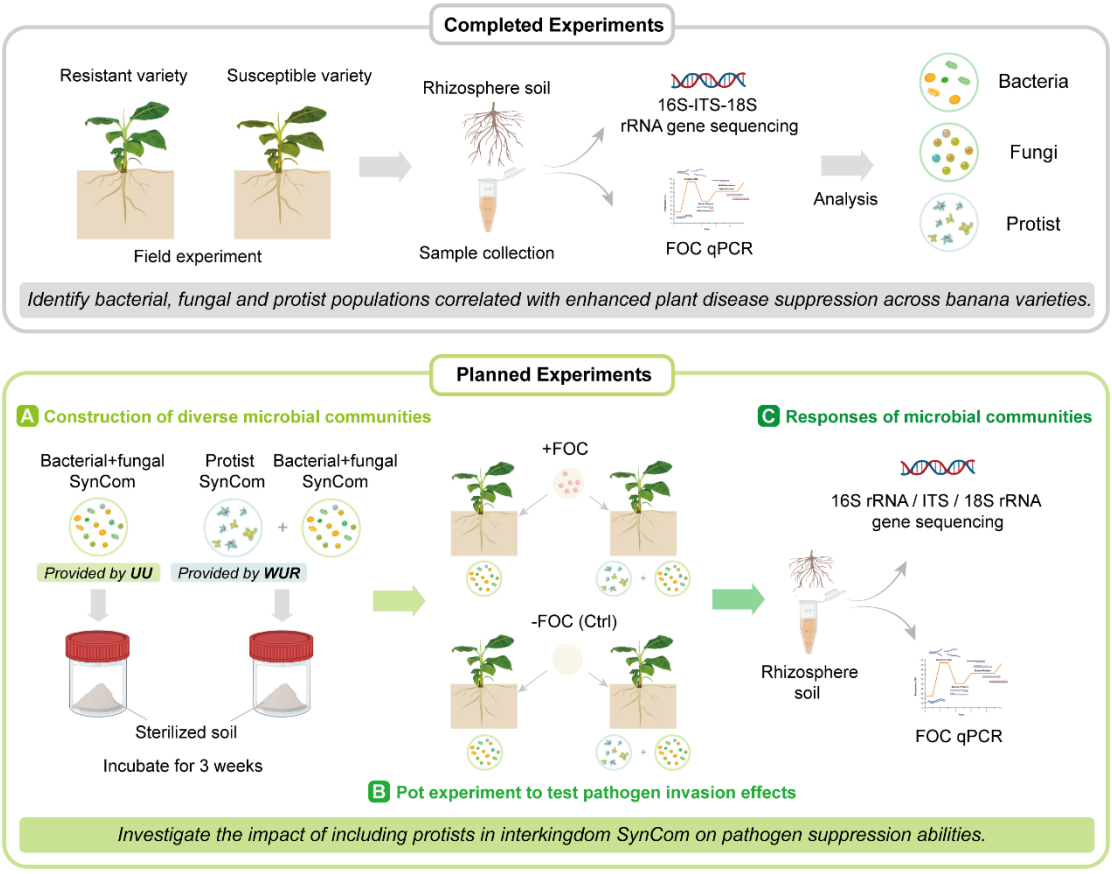

Fig 1. Experimental design of the project. SynCom: synthetic community. FOC: *Fusarium oxysporum* f. sp *cubense*.

Relevance given the PE&RC mission (Understanding the functioning of natural and managed ecosystems to improve the quality of life) (max. 150 words)

Our project aims to reveal how plants regulate the composition and structure of the soil micro-food web to enhance their disease resistance. Soil-borne disease poses a severe threat to the survival and development of many plants in both natural and agricultural systems, highlighting the urgent need to unlock and steer soil functions for sustainable development in agroecosystems. Previous research highlights the importance of cross-kingdom interactions between bacteria and fungi in boosting disease suppression, alongside the significant role of microbial predators. Expanding the plant cry for help paradigm to the micro-food web —comprising bacteria, fungi, and protists and combining it with the interactions between predators and prey, not only helps reveal the key mechanisms of rhizosphere microbial interactions, but also offers innovative strategies for agricultural and ecosystem management. This approach helps guide soil functions toward more sustainable practices, benefiting both society and nature.

The manner in which the proposed project will strengthen the institutional collaboration, identifying the specific role of the proposed candidate(s) (postdoc/PhD), including the expected output of the project (max. 150 words)

The Ecology and Biodiversity Group at UU has a strong track record in research focused on

understanding the drivers of soil bacterial and fungal community assembly, as well as the microbial enhancement of plant stress tolerance. The WUR Laboratory of Nematology has provided novel insights into the functionality of microbial predators in soil and how their activities affect soil disease dynamics. This project innovatively integrates these two perspectives to expand the cry for help paradigm, incorporating protists and their trophic interactions with bacteria and fungi. The results of this collaborative project will result in a joint publication in an international peer-reviewed journal in the field and be presented at relevant academic conferences. It is also expected that the results gleaned from this experiment will fuel future collaborative efforts between the two partner groups. The project will be executed by the PhD candidate, as co-supervised by the two partner PIs.

Groups involved

This project involves two groups within PE&RC: Laboratory of Nematology, Wageningen University and Research and the Ecology and Biodiversity Group, Utrecht University

Scientists involved

Dr. Stefan Geisen, Prof. Dr. George A. Kowalchuk

PhD candidate(s) or postdoc(s) involved and time to be spent on the project by the Postdoc(s) / PhD candidate(s)

The PhD candidate, Shanshan Liu, will dedicate 4 months to the project.

Appointment details: name of person(s) employed, employment period, chair group

Name of person(s) employed: Shanshan Liu (PhD candidate)

Employment period: Four-month period, January 2025 - April 2025

Chair group: Laboratory of Nematology, Wageningen University and Research.

The budget requested

Gross salary costs for one PhD candidate (last year) for four months. And 35% overhead of the project for experimental materials and detection such as qPCR, and sequencing.