Mechanisms determining the suitability of selected entomopathogenic fungal species for biocontrol - a multi-omics approach

Entomopathogenic fungi are natural enemies of pests. They are environmentally friendly microorganisms used mainly in agriculture, where they protect crops from pests and reduce the need for chemical pesticides. Most commercially available biopreparations contain fungi from the genera *Metarhizium* and *Beauveria*. In contrast, there are other types of fungi in the environment that are not used at all in the production of biopreparations but are just as effective at controlling pests as the two types mentioned above. Such microorganisms include, for example, fungi from the **genera *Samsoniella, Akanthomyces* and *Hirsutella***, which have unique and potentially valuable biological properties and could be used for pest control or as plant growth enhancing microorganisms. Due to the lack of sufficient research on their mode and scope of action, they remain underutilized.

This project is based on the assumption that entomopathogenic fungi of the *Samsoniella, Akanthomyces* and *Hirsutella* genera not only have the ability to control crop pests, but also **have unexplored potential** due to their poorly understood metabolism and mode of action.

This four-year interdisciplinary project is primarily focused on basic research. By integrating biological, chemical, omics and bioinformatics research, the **project aims to improve the knowledge of less commonly used and underestimated entomopathogenic fungal species with significant infectious potential**, thus enabling the future development of innovative bioinsecticide formulations.

The specific objectives of the project are to understand the mechanism of insect infection by fungi of the genera *Samsoniella*, *Akanthomyces* and *Hirsutella* using advanced techniques such as genomics, transcriptomics, metabolomics and proteomics; to discover how these beneficial strains interact with plants; and to understand how the use of these fungi for insect control will affect other soil and plant microorganisms. In the final phase of the research, we will assess whether toxins (pesticides and mycotoxins) present in the environment interfere with the insect control processes of these fungi.

The breakthrough nature of the project is related to the discovery of new environmentally friendly biocontrol agents that will contribute to biodiversity conservation and promote ecosystem equilibrium by balancing pest populations; learning new ecological roles and adaptive capacities of entomopathogenic fungi, leading to increased awareness of microbial biodiversity and soil quality; To discover new genes, metabolic pathways and regulatory networks of fungi that are crucial for their pathogenicity and interactions with hosts; to provide valuable data on the safety of fungal metabolites and their effects on non-target organisms, which is crucial for environmental risk assessment.

In summary, this project will provide fundamental knowledge to understand how to develop new, safe biopesticides that are effective in the environment and fill the gap left by the withdrawal of pesticides.