Research project objectives: By 2050 the global population will reach 9.7 billion, increasing global food demand. Many factors, from climate change, limited agricultural lands, irrigation problems, and plant diseases, make producing enough food challenging. Pest and plant pathogens (fungi, viruses, bacteria) are responsible for a 40% loss in global food production, costing the global economy 220 billion US$ annually. Moreover, natural toxins such as mycotoxins produced by fungi can contaminate a wide range of food and feeds represents a serious risk for human and animal health. Cereals are the most important crops worldwide, providing the main raw materials for the food and feed industry. **The appropriate disease management strategy in cereal crops is therefore crucial to fighting global food insecurity. To address this challenge, the goal of the following project is to** i) analyze the actual phytosanitary status of cereal crops, including pathogen diversity and population structure, ii) analyze the influence of climate change on the pathogen prevalence, and iii) indicate the level of mycotoxins in grains and field soil. This knowledge is crucial to develop a management strategy, including investing in sustainable agricultural practices, adopting climate/pest/pathogens-tolerant crop varieties, promoting integrated pest management, building eco-awareness, and networking between growers, scientists, and policy makers. Additionally, results obtained in the following project may serve as a basis for pest risk assessment for other countries.

Research project methodology: The surveys will be conducted during the 2025-2027 growing season of two winter wheat and barley varieties, in two grown stages, in six localizations of three climatic regions: North, Central, and South Poland. The actual population structure of plant pathogens and identification of new species that occurred in Poland will be carried out using conventional as well as modern molecular biology techniques, including high-throughput sequencing (HTS). Moreover, the analysis of mixed infection occurrence, recombination events, phylogenetic relationships, and genetic diversity of detected pathogens will be also performed. Simultaneously, the harvested grains and soil collected from the same fields will be collected, and mycotoxin contamination will be analyzed using the liquid chromatography-tandem mass spectrometry (LC-MS/MS) technique. The climate conditions (temperature, rainfalls), crop management, presence of insects, chemical treatments, etc. will be monitored throughout the research period. These data will be used to perform statistical correlation analysis between geographic localizations, weather conditions, tested cereal species and their varieties, the occurrence and structure of detected pathogens, and high toxin levels.

Expected impact of the research project: The implementation of the results obtained in the following project will provide extensive knowledge regarding the threats posed by pathogens to cereal crops, the impact of changing climatic conditions on their population structure, and the level of mycotoxin accumulation in grains and soil. This knowledge is crucial to designing disease management programs to avoid and even reduce negative effects on human health and the environment**. The results of the project will be strengthening the phytosanitary and food safety system.** The results will also provide a base for pest risk assessment for neighboring countries. Therefore, it is essential to spread and deliver knowledge gained in this project to the wildest range of recipients through scientific papers, reports as well as popularization activities.