

1. PHD PROJECT DESCRIPTION (4000 characters max., including the aims and work plan, all in English)

Project title:

Bioactive substances as an alternative to synthetic plant protection products directed against fungal phytopathogens

1.1. Project goals

The aim of the project is to look for natural bioactive substances that could be used in the protection of plants against fungal diseases. The agricultural industry in Poland is very developed, so the fight against pathogens in plants is extremely important. Fungal phytopathogens are a common problem in the production of food of plant origin. Aggressive cultures are able to decimate crops in a short period of time. Currently, many forms of prevention against fungal diseases are used. They are usually synthetic antifungal agents. The priority is to develop a plant protection method that is effective for fungal infections, but is harmless to humans and the environment. They are working on the use of natural compounds of plant origin as an alternative to synthetic chemical compounds. Polyphenols including flavonoids and polyphenolic acids represent one of the largest and most studied classes of phenylpropanoid-derived plant specialized metabolites. These substances are commonly present in the plant world. Polyphenols belong to the most important secondary metabolites of plants which play an important role in natural plant defence against phytopathogenic fungi (Gurjar et al. 2012; Zabka and Pavela 2013). Antifungal effects of different phenolic compounds have been in e.g. *Fusarium oxysporum*, *F. verticillioides*, *Penicillium brevicompactum*, *Aspergillus flavus*, *A. fumigatus* (Dambolena et al. 2012; Zabka and Pavela 2013), *Phytophthora megasperma*, *Cylindrocarpon destructans* (Báidez et al. 2006).

1.2. Outline

1. Selection of bioactive substances and fungal phytopathogens
2. Determination of minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC) on growth of phytopathogens
3. Determination of the effect of the carrier on the efficacy of the selected bioactive substances against fungal phytopathogens
4. Determination of phytotoxicity on selected crop plants
5. Determination of antifungal activity of the formulations on selected crop plants
6. Evaluation of the effect of the most effective preparations on soil biodiversity and their enzymatic activity

7. Preparation of results and publication

1.3. Work plan

First year

- Selection of bioactive substances and fungal phytopathogens - various bioactive substances with antifungal potential will be selected based on the literature.
- Fungi that will pose the greatest threat to plants will be selected for testing: *Fusarium*, *Alternaria*, *Botritis*, *Sclerotina*.
- Infected plants (e.g., cucumber, tomatoes, peppers) will also be selected for testing, from which the fungi will be isolated and identified based on 18S rRNA gene sequences
- Determination of the minimum concentration (MIC), and the minimum fungicidal concentration (MFC) of bioactive substances on spore germination and mycelium growth of fungal phytopathogens.
- Preparation of a grant to NCN, IDUB

Second year

- Determination of the effect of the carrier on the efficacy of the selected bioactive substances against fungal phytopathogens. It is assumed that the carrier of bioactive substances will be, among others, emulsifiers and adjuvants used in agriculture. In this experiment, the MIC and MFC of the preparation will be determined.
- Determining the phytotoxicity rate and assessment of the effects of bioactive substances on the inhibition of the fungal phytopathogens growth.
- Based on the results obtained, the following publications will be prepared

Third year

- Determination of antifungal activity of the formulations on selected crop plants. The experiment will be conducted in several variants: determination of the fungicidal activity of the emulsion on seeds, testing of the effectiveness of the emulsion introduced topically on phytopathogens, testing of the effectiveness of the emulsion introduced superficially on phytopathogens
- Evaluation of the effect of the most effective preparations on soil biodiversity. The aim of this experiment will be to investigate to what extent selected bioactive preparation will change the diversity of soil microorganisms and their enzymatic activity
- Based on the results obtained, the following publications will be prepared

Fourth year

- complementary research and analysis
- presentation of results at conferences
- preparation of the doctoral dissertation
- dissertation defense
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1.4 Literature

- Báidez, A. G., Gómez, P., Del Río, J. A., & Ortuño, A. (2006). Antifungal capacity of major phenolic compounds of *Olea europaea* L. against *Phytophthora megasperma* Drechsler and *Cylindrocarpon destructans* (Zinssm.) Scholten. *Physiological and Molecular Plant Pathology*, 69(4-6), 224-229.
- Dambolena, J. S., López, A. G., Meriles, J. M., Rubinstein, H. R., & Zygadlo, J. A. (2012). Inhibitory effect of 10 natural phenolic compounds on *Fusarium verticillioides*. A structure–property–activity relationship study. *Food Control*, 28(1), 163-170.
- Gurjar, M. S., Ali, S., Akhtar, M., & Singh, K. S. (2012). Efficacy of plant extracts in plant disease management.
- Zabka, M., & Pavela, R. (2013). Antifungal efficacy of some natural phenolic compounds against significant pathogenic and toxinogenic filamentous fungi. *Chemosphere*, 93(6), 1051-1056.

1.5 Required initial knowledge and skills of the PhD candidate

- an interest in the risks associated with plant fungal diseases
- knowledge of biology, microbiology and biochemistry
- experience and ability in a microbiology laboratory
- ability to work in a team
- communication skills, creativity, analytical thinking, perseverance

1.6. Expected development of the PhD candidate's knowledge and skills

significant research development in the field of microbiology

- ability to perform microbiological analyses related to the dissertation topic and research beyond the scope of the PhD activities
- ability to present research results at national and international conferences
- internships in research centers (Polish and foreign)
- ability to obtain funds for research
- participation in popularization classes
- ability to work with students