mgr inż. Karolina Stałanowska

Doctoral thesis: Silver nanoparticles in the protection of pea (*Pisum sativum* L.) seeds and seedlings against fungal pathogens

Abstract

Pea (*Pisum savtivum* L.) is an economically important crop, cultivated primarily for its seeds, which are characterized by high nutritional value. A major threat to pea cultivation is posed by fungal diseases – Ascochyta blight and pea root rot caused by *Didymella pinodes* and *Fusarium avenaceum*, respectively. Due to the lack of resistant cultivars and legal restrictions on the use of fungicides, there is a growing need for new active substances for use in plant protection products. Silver nanoparticles (AgNPs), because of their high fungistatic activity, are considered a promising alternative. However, there is a lack of data on the effect of AgNPs on *D. pinodes* and *F. avenaceum*.

The aim of this work was to evaluate the efficiency of AgNPs in protecting pea against *D. pinodes* and *F. avenaceum*. The following aspects were analyzed: (1) the fungistatic activity of selected AgNPs against both pathogens, based on the minimum inhibitory concentrations and the inhibition of mycelium growth; (2) the efficacy of foliar application or seed nanopriming with AgNPs in protecting pea seedlings against infection (based on the disease index and infection levels determined by qPCR); (3) the impact of AgNPs on the activity of the seedlings' antioxidant system; (4) the effect of AgNPs and fungal infection on seedlings' metabolic profiles, analyzed using gas chromatography.

The obtained results demonstrated high effectiveness of biologically synthesized silver nanoparticles (bio-AgNPs) in suppressing the infection caused by both fungal pathogens, with effects comparable or greater (as seed nanopriming) than available plant protection products. Both bio-AgNPs and *D. pinodes* and *F. avenaceum* infection affected the metabolic profiles of root, epicotyl/shoot and cotyledons due to changes in the content of dominated (quantitively) polar metabolites: sucrose, homoserine, asparagine, malic or citric acid. The observed changes were influenced by both the bio-AgNPs concentration and the fungal species infecting the seedlings.

keywords: pea, silver nanoparticles, metabolite profiling, *Didymella pinodes*, *Fusarium avenaceum*