Proposal of PhD project to be realized within EU project „Program doskonalenia dydaktyki SGGW w dziedzinie pozyskiwania surowców roślinnych dla energetyki w kontekście celów Strategii Europa 2020"

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PhD project title

Mechanisms underlying the trade-off between development and immunity on the model of nematode-induced feeding cells - maximizing biomass yield for renewable energy production.

(Kontrolowanie równowagi procesów rozwojowych i obronnych na modelu struktur korzeniowych indukowanych przez pasożytnicze nicienie glebowe w celu maksymalizacji produkcji biomasy na cele energetyczne.)

Plant parasitic nematodes cause tremendous yield losses of many cultivated plant species reaching over 100 billion euro annually worldwide [1]. Among nematode hosts there are many crops important for bio-fuel or energy production such as potato, sugar beet, soybean, oilseed rape, maize as well as important woody plants - willow and pine [4]. Most of plant parasitic nematodes infect and feed on roots and cause unspecific symptoms of water and nutrient deficiency limiting directly biomass production. Equally severe yield losses are due to secondary disease infections on nematode infested roots.

The final implementation of EC directives regulating use of plant protection products has removed one of the two cornerstones of nematode control – pesticides and host resistance - from European food production. No effective replacements for withdrawn pesticides are currently available, while resistance against nematodes is still lacking in many commercially viable cultivars. Consequently, growers across Europe face increasing problems in dealing with a 'silent' build-up below ground of indigenous and introduced plant parasitic nematodes. Moreover control difficulties and durability of soil contamination subjected several parasitic nematode species the quarantine regulations. Current breeding of natural resistance against nematodes in food crops by the European plant breeding industry is still largely based on trial-and-error and is too slow to compensate for the loss of pesticides. The lack of scientific understanding of the regulation of virulence in nematodes and resistance in plants has hampered rational design of nematode resistant crops [3]. However, the recent completion of genome sequences for major nematode pests and many important crop plants offers an unprecedented opportunity to accelerate breeding of nematode resistant plants [6]. These genome sequences offer a unique opportunity to develop high-throughput selection strategies for natural nematode resistances in breeding programs as well as faster identification of critical signaling pathways transmitting nematode effector stimuli to host plant defense and developmental programs. [2,5].

This project aims to characterize important signaling pathways in model plant *Arabidopsis thaliana* infected with beet cyst nematode *Heterodera schachtii*. Project will concentrate on pathways related to reactive oxygen species molecules and plant hormones – auxins and strigolactones. The phenotype and molecular analyses will focus on available mutants of *Arabidopsis* genes related to biosynthesis of specific signaling compounds and transduction of signals related to biotic stress. If available the overexpressing and silencing lines will be also analyzed. The main focus will be on signals related to already identified nematode effectors [3]. The results will be *in silico* confronted with genomic data of energetic plants and their nematode pests. Moreover we intend to point and elucidate the role of plant processes and genes integrating signals of other than nematodes pests, pathogens and abiotic stress. Such multidisciplinary research is required to translate the genome information into novel tools and targets for efficient breeding of durable biotic and abiotic stress resistance. Such broad spectrum stress resistance is an essential factor for integrated and sustainable maximizing biomass production.

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