Research project objectives

Modern agriculture is facing many challenges, which are undoubtedly focused on increasing productivity, combined with limited use of conventional pesticides, including herbicides or fungicides. In this situation, we are looking for alternative methods of protecting plants with high efficacy at low doses. One of these are systemic acquired resistance inducers whose function is to stimulate the natural resistance mechanisms of the plant (acting analogously to vaccines for humans or animals) preventing the viral or fungal infections. Most of the inductors has a structure of carboxylic acids or their derivatives (eg. esters, thioesters or amino acids) that are just inside the plant metabolized by hydrolysis what induce immunity.

Project objective is to examine the influence of the structure, in particular a carboxylic acid derivative and its susceptibility to hydrolysis, on the biological effectiveness of plant resistance inducers. Research hypothesis assumes that there is a relationship between the structure of functional group (exactly its susceptibility to hydrolysis) on the effectiveness of the biological inducers of plant resistance. Confirmation of this hypothesis will provide (i) the conscious design of new inducers of plant resistance, (ii) increase in the biological efficacy of new derivatives and (iii) confirmation of the mechanism of induction of immunity.

Research methods

The project will be implemented in four stages. The first is design of plant resistance inducers derivatives such as salicylic acid, nicotinic acid or 7-carbothiatebenzo[1,2,3]tihiadiazole. The direction of modification of these molecules is determined by the potential for hydrolysis of the attached functional group (e.g. tosyl, mesyl, *tert*-butyl, phenyl, benzyl, or amide). The higher, the greater biological activity. In the second stage, the resulting compounds will be tested for their physicochemical properties such as thermal stability or melting temperature and susceptibility on the hydrolysis process. In the third stage of the research resulting compounds will be tested for their biological activity, e.g. the induction of resistance in a Tobacco Mosaic Virus - Tobacco Plants system. Plants sprayed or watered with a solution of active substance will be after 7 days mechanically infected with a virus (which will be rubbed in their leaves). After a further 5 days will be counted number of necrotic spots on the surface of the plant and compared to controls. Their reduction, compared with the control, will determine the degree of inhibition of viral disease thus induction of immunity. In the last fourth stage, biological data will be correlated with susceptibility to hydrolysis. Finally, the selected substance having high biological activity will be modified to slightly change the hydrolysis susceptibility of a particular functional group what will eliminate the influence of the structure of that group on the biological activity itself.

Justification for tackling specific scientific problems by the proposed project

Experience of our research group connected with the current literature data shows that there is a link between structure of functional group in used acid derivative and its biological efficacy. Implementation of this project will provide an answers to the questions (i) whether the application of a good leaving group (biologically neutral) will increase the effectiveness of SAR and (ii) whether it will be a linear relationship. Obtained during the course of the project results will allow for finding the relationship between the structure inducers of plant resistance and their biological efficacy. This relationship will allow for future purposeful design and synthesis of these types of compounds with high efficiency as well as the possible basis for a better understanding of the mechanisms of induction of resistance in the plant. In addition during the proposed research will be obtained and characterized more than 20 new derivatives of currently known inducers of predicted high efficiency, which will expand the range of available substances with verified biological effect. Thus obtained compounds fits perfectly into a modern convention for the protection of plants assuming the use of "smart" and highly specialized plant protection products, which hopefully lookout for the XXI century agriculture.