

NEWS FROM CRH

February 2019



CENTRE OF THE REGION HANÁ
FOR BIOTECHNOLOGICAL AND
AGRICULTURAL RESEARCH



efb



INTERVIEW

Allow me to start with a very important event - at the end of last year you have received the highest Czech award for science - Czech National Award "Česká hlava". How do you feel about that?

Honestly, it is a mixture of feelings. Of course it was a huge surprise, I did not expect anything like that. When I realized how prestigious it was and how important it was, a certain weight of responsibility fell upon me as well. But I am truly very happy.

You are definitely ranked among the scientific elite of the Czech Republic, in your field you are, of course, a respected personality in the world. Was this one of your dreams since the beginning of your career?

Maybe it sounds incredible, but I am not an extrovert. I never wanted to be in the spotlight. On the other hand, however, it is true that I have always tried to do my best at work, since I was brought up to compare myself with the best. That is why I have always been trying to do science as best as I can, and therefore a bit different than others. Not primarily because of the awards. I take those rather as proof that someone has noticed our work.

How did you get to the scientific profession? Did you want to be a scientist as a child?

No, it was more because at important crossroads in my life, I have set out in a good direction. I have always been lucky with people and events surrounding me. One such important turning point came during my studies of horticulture at the University of Agriculture. At that time Prof. Lužný sent me to do research for my diploma thesis to the Institute of Experimental Botany, where I stayed until this day. At the Academy of Sciences, I took a look into top science, and that made me decide. I was impressed by the creativity, I was able to discover new things, to communicate with my colleagues abroad. With my diploma thesis I won a nationwide competition and got an offer for doctoral study.

During that time, you have started your life-long scientific focus?

Yes. I was dealing with changes in genetic information in cell culture in vitro. That was the moment I became a professional geneticist. Thanks to my supervisor I got to cytometry, which is my life-long love. I traveled daily to Brno to pathology at St. Anne's Hospital to measure DNA content in cells and learned a lot. There I also learned about flow cytometry and, after doctoral studies, I convinced my boss to buy the device. At that point I already knew that I

JAROSLAV
DOLEŽEL

Scientific
Director of CRH



wanted to study hereditary information using cytometric methods. Together with my colleagues we have been treading the path in many areas of use of flow cytometry in plant biology.

You have contributed a great deal to reading the genome of barley, banana and last year also wheat. How long was the journey and which of the crops was the most difficult?

To this day, we are mostly troubled by banana plant. Despite its small genome, it is the most difficult one. Maybe

that is why I enjoy it. If I had to choose only one plant for research, I would choose a banana tree. And as for the journey, it was long and we did not know where it will lead us at the beginning. As I said, I loved cytometry, which we initially used for cell nucleus analysis. But I was attracted by the combination of cytometry and genome analysis. It took a few years, but we have developed a method of isolating chromosomes and then sorting them using flow cytometry. I was convinced that this is the right approach and I wanted to apply it to plants. We started on beans and peas, then we focused on cereals, first on barley. We adjusted the method for grain and then modified it for much more complex wheat. An international consortium was established in 2005 and our method has become its main procedure.

What challenges are now ahead of you?

We are completing sequencing of the rye genome, which should be published this year. It brings an end to one stage - reading genomes. Now we are interested in organizing the genome in three-dimensional space of the cell nucleus. That is what we are currently studying, among other things, thanks to the research project within OP R&DE,

"We have excellent working conditions here. Everyone who comes to CRH from abroad is in awe."

which CRH received in the Excellent Research call. We will use the super-resolution microscope we are currently purchasing. We study how hereditary information is organized and how it affects plant properties. This is a new area for us. We are once again at the beginning.

Research results should contribute to breeding crops with higher yields and resistance to negative environmental influences. There is talk of the so-called Second Green Revolution, of which you are a supporter. In what state are we now?

The trial is already under way, but the European Court of Justice keeps crimping it. New breeding methods are basically based on the ability to change hereditary information. Luckily for humanity, scientists have discovered the CRISPR / Cas9 system in bacteria that can change hereditary information just as accurately as the surgeon cuts with a scalpel. This principle is inspired by nature, humanity has only learned from bacteria. Yet we are forbidden to use it. But without genetically modified crops, we cannot feed humankind.

In Olomouc you have built an internationally renowned workplace, you are CRH Scientific Director. Have you considered job offers from abroad?

We have excellent working conditions here. Everyone who comes to CRH from abroad is in awe. In principle, we are absolutely comparable to foreign workplaces. So why leave? I do not have the slightest reason.

UP is considering setting up a new university institute, including CRH. Do you support this idea?

Certainly. I see the new Institute as a chance to move science in Olomouc to an even higher level. Some things may not be clear, but I like visions. It is important for me to believe this is the right way. There may be some obstacles, but it is important to agree. It is about whether or not we want to. And I see the “not wanting” as a comfortable decision that will lead to a satisfactory average where everything will stay as it was. Or we will move on. That is the decision we are facing.

SCIENCE AND RESEARCH SCIENTISTS HAVE CALLED FOR A CHANGE IN EUROPEAN LEGISLATION



European legislation on genetically modified plants does not correspond to current scientific knowledge and can damage European agriculture and the environment. Therefore, it is necessary to strive to change it. With this appeal, CRH Director Ivo Frébort and Scientific Director Jaroslav Doležel addressed the Czech Prime Minister and the Minister of Agriculture and Environment at the end of last year.

The letter was a response to the ruling of the European Court of Justice, according to which organisms obtained by modern methods for targeted genomic editing, such as CRISPR / Cas9, are subject to the same strict regulation as genetically modified organisms. That is what the researchers refuse to accept.

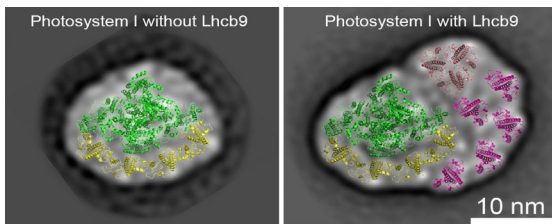
“The verdict does not make sense from a scientific point of view, because crops with small modifications of genome are as safe as crops obtained by classical mutagenesis and traditional methods of breeding. The consequences of this decision will be far-reaching. Innovative agricultural research will move out of Europe, which will make it difficult to catch up in this area. It will be difficult to grow new varieties of agricultural crops, which will reduce the competitiveness of European agriculture and slow down the introduction of sustainable farming methods,” said Frébort.

CRISPR method is based on the fact that scientists can “shut down” a gene in the genome, which carries a specific property. This makes it possible to obtain plants with the desired properties, such as resistance to drought or disease. Without such varieties, as the authors of the letter say, it will not be possible to provide enough food for the growing world population.

BIOPHYSICISTS DESCRIBED KEY PROTEIN FUNCTION OF MOSSES

Biophysicists from CRH together with colleagues from Italy, Finland and the Netherlands described the crucial role of Lhcb9 protein for moss function. They have found that this protein allows mosses to provide the light needed for photosynthesis even in shady forests. Unique findings have been published in the prestigious journal *Nature Plants*.

The aim of the scientists was to describe the structure of photosystem I isolated from moss and to determine how the presence or absence of the so-called antenna protein Lhcb9, which can absorb light, affects it. Researchers in



Olomouc investigated photosystem I isolated from wild-type moss and compared the results with a mutant plant lacking the Lhcb9 protein. For isolation, they used a special method of colorless native polyacrylamide electrophoresis that allows gentle separation of unstable photosynthetic complexes without causing damage to them. “We found that the presence of Lhcb9 protein is very important for photosystem I to be able to bind multiple antenna proteins and absorb more long-wavelength light. This is essential for the adaptation of moss to its natural environment in which this kind of light is relied on,” explained Roman Kouřil, a biophysicist. For the professional world, the information about the importance of Lhcb9 and the structure of the photosynthetic system I in *Physcomitrella* was completely new. It was expected that mosses do not have chlorophylls at all capable of absorbing long-wavelength light. Now, however, it is obvious that this function is filled by Lhcb9 protein, which also allows the binding of other antenna proteins that enhance absorption of light.

Pinnola A, Alboresi A, Nosek L, Semchonok D, Arshad R, Trotta A, Barozzi F, Kouřil R, Dall’Osto L, Aro EM, Boekema EJ, Bassi R (2018) A Lhcb9-dependent photosystem I megacomplex induced under low light in *Physcomitrella patens*. *Nat. Plants* 4, 910-919. IF= 11.471

“101” METHOD FOR PLANT HORMONES

To measure a record-high number of 101 plant hormones and related substances in a single small sample of root, stem or other organ allows a method developed by scientists from the Olomouc worksite of Institute of Experimental Botany of AS CR, Palacký University and CRH. The new procedure speeds up hormonal analyses and helps clarify how their levels change in different situations, for example, when crops or other plants face unfavorable conditions.

“Our method is fast, sensitive and reliable even with small plant samples weighing just 20 milligrams. In each sample, we can simultaneously determine up to 101 substances, which is almost double compared to the previous methods of other authors,” said Ondřej Novák, who developed the method together with his Olomouc team and scientists at the agricultural university in Umeå, Sweden. “We use mass spectrometry because it is extremely sensitive and can accurately identify the compounds that interest us. The whole analysis will take just 32 minutes,” added Jan Šimura, another member of the Olomouc team. The

practical applicability of the method was verified on the seedlings of *Arabidopsis thaliana*, which was exposed to salinity stress. The article describing the newly developed method was published in *Plant Physiology*.

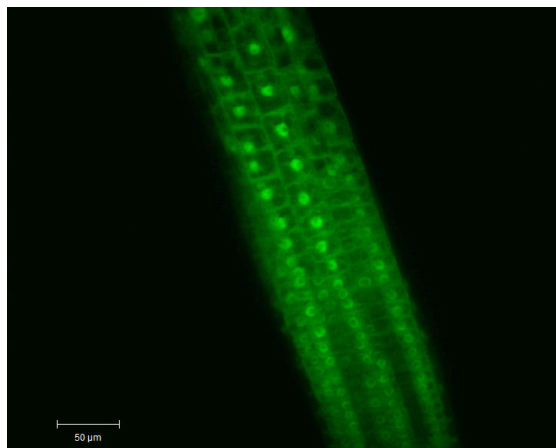
Šimura J, Antoniadou I, Šíroková J, Tarkowská D, Srtnad M, Ljung K, Novák O (2018) Plant Hormonomics: Multiple Phytohormone Profiling by Targeted Metabolomics. *Plant Physiol.* 177, 476-489. DOI: 10.1104/pp.18.00293. IF=5.949



SCIENTISTS HAVE ADVANCED IN THE MICROSCOPIC EXAMINATION OF PLANTS

Another significant step in the research of plant development and their internal arrangement by fluorescence microscopy has been made by scientists from the Department of Cell Biology at CRH along with colleagues from the University of Nottingham and the Max Planck Institute of Molecular Cell Biology in Dresden. In a special microscope, they can observe for several days not only the model plant *Arabidopsis thaliana*, but also *Medicago sativa* in its natural state. The results were published in the prestigious journal *Nature Plants*, which also outlined the perspective of the method to the whole world.

“We have succeeded in further developing a method that has as the only one been able to scan plants at different levels from intracellular to whole plants. The fact that we have advanced from *Arabidopsis* to *Medicago* is a great milestone. We can watch the plant from a few hours to several days as if it were in its natural setting. We see not only its development but also interactions with external environment and microbes in defined and strictly controlled conditions. We will get a much better answers



to a range of biological and biotechnology issues,” said Olomouc research group leader Jozef Šamaj. According to him, the information obtained is crucial for increasing plant yields or resistance to adverse environmental impacts, including drought or disease. Researchers intend to continue to improve the methodology also within an Operational Program Research, Development and Education project called Plants as a means of sustainable global development, and to adapt it for use in barley.

Ovečka M, von Wangenheim D, Tomančák P, Šamajová O, Komis G, Šamaj J (2018) Multiscale imaging of plant development by light-sheet fluorescence microscopy. *Nat. Plants* 4, 639-650. IF = 11.471

BRIEFLY

Mathieu Wellhoff, Attaché for Science and Universities of the French Embassy in Prague visited CRH in January. He became acquainted with the most important research directions and results, and CRH representatives also discussed the possibilities of further cooperation. “In Prague where our embassy is located, there is much talk about science in Prague and Brno. However, what we saw in Olomouc was really amazing. Scientific centers are at a much higher level than we expected. I was most intrigued by the fact that smaller research centers can achieve better results than much larger scientific institutions,” said Wellhoff, who also visited the Regional Center of Advanced Technologies and Materials in Holiche campus of the Faculty of Science.

CRH’s further development strategy was one of the main points on the agenda of the Board of Directors meeting, which took place on December 13. The strategy was presented by CRH Director Ivo Frébort, who outlined the following goals: high quality of science and research, new interdisciplinary directions, participation in teaching at the Faculty of Science, international orientation and partnership, as well as greater involvement in regional development. He also outlined what steps will be

crucial for achieving these goals, including the need to secure sufficient funding and to expand or restructure research teams. On the same day, the Executive Board meeting was also held. Among other things, there were preliminary reports on the completion of terminating projects and information on the start of OP R&DE projects Excellent research - Plants as a tool for sustainable global development and Pre-application research for ITI - Development of pre-application research in nanotechnology and biotechnology. Since January 3, a new Partnership Agreement and Constitution of CRH have been in force.

Scientific Board of Czech Grant Agency is now headed by CRH Scientific Director Jaroslav Doležel of the Institute of Experimental Botany. The board was completely redesigned at the proposal of the Board for Research, Development and Innovations and has 12 members working in the Czech Republic as well as abroad. Professor Doležel replaced Prof. Zdenek Bittner of Czech Technical University. The Scientific Council is the Agency’s conceptual body, proposes to the Bureau the establishment and focus of Sectoral Committees and evaluates the scientific level of the Grant Agency.

CONGRATULATIONS

PHYTOCHEMIST IS ONE OF THE WORLD'S MOST CITED SCIENTISTS

Among the 12 representatives of domestic research institutions and universities who have entered the list of most cited scientists in the world - Highly Cited Researchers 2018, there is also an analytical chemist and phytochemist Ondřej Novák of the Laboratory of Growth Regulators.

"I very much appreciate being among highly cited scientists. I think this success cannot be seen just as an individual award, so I would like to thank my colleagues very much. It is a clear proof for me that the long-term work of our team has not only a national but also international overlap," said Novák, who studies the biosynthesis and metabolism of plant hormones using modern mass spectrometry and the relationships between their chemical and biological activity. He and his team have successfully developed methods that can measure the concentration of dozens of hormones and their related compounds in miniature plant tissue samples. Novák has been, according to the Web of Science database, the author or co-author of more than 250 publications that received over 5000 citations.



THE DIRECTOR OF CRH AWARDED 20 SCIENTISTS

The Director's Excellence Award was received by 20 authors of major scientific publications, patents, grants, and the results of applied research.

The laureates received them at the December Scientific Board meeting, where they presented their papers. A total of 20 publications were nominated for awards in the category of scientific publications, which ranked in the top twenty percent of their respective fields according to the Web of Science database and whose main author is from CRH. Half of the proposed papers was selected. List of all awarded http://www.cr-hana.eu/wp-content/uploads/2018/12/Ceny_reditele_2018_final.pdf

BEST LECTURE AWARD

The award for the best lecture at the Spanish-Portuguese Conference on Advanced Optical Microscopy (SPAOM2018 - Spanish Portuguese Meeting for Advanced Optical Microscopy) was at the end of October received by Miroslav Ovečka of the Cell Biology Department. He aroused interest of other participants by presenting the results of his research group from monitoring the development of live plants using advanced microscopy.

He has succeeded in the competition of 38 lectures given in the main scientific program by representatives of leading European laboratories. Only a minor part was devoted to the microscopy of plant objects.

GRANTS

COMPETENCE CENTER WILL CONNECT RESEARCHERS AND BREEDERS

The Olomouc worksite of the Institute of Experimental Botany (IEB) of the Czech Academy of Sciences, part of the CRH, is a member of the newly established Biotechnology National Competence Center for Plant Genotyping. It is the only national center of competence in biological sciences that strives to link basic and applied research in the field of plant biotechnology with breeding companies and thus to support the competitiveness of Czech agriculture with an overlap to food processing, brewing and malting sectors.

"It is the first project of its kind in the Czech Republic and we are very pleased to be involved. There are methods that we can do best in the world, and I am pleased that we can offer our know-how to breeders and link science to practice as is common in many Western European countries today. Large breeding companies in France, Germany, the USA or England have their own laboratories



focused on molecular biology and genomics. In the Czech Republic, the situation is different and for most companies the establishment of such laboratories is beyond their financial possibilities. Without new methods, however, Czech breeders would not be able to compete abroad," said Jaroslav Doležel, head of Olomouc workplace of IEB and CRH Scientific Director.

At the Biotechnological National Competence Center for Plant Genotyping, which is a program of the Technology Agency of the Czech Republic (TA CR), seven other research institutes and four commercial companies cooperate. The whole project is coordinated by Agricultural Research Troubsko. TA CR subsidy amounts to CZK 56 million for all participating institutions for a two-year pilot period. After this stage, an extension by three years is foreseen.

EFB EXECUTIVE BOARD MEETING TOOK PLACE

European Federation of Biotechnology (EFB) will continue to be headed by the Swedish biologist Mathias Uhlen. On January 26, Barcelona hosted a meeting of the Executive Board of EFB, which the director of CRH Ivo Frébort is a member of. Agenda included the strategy of the Federation in the coming years and preparation of the European Congress of Biotechnology which will be held in Maastricht in 2020.

“The Executive Board has confirmed both the current President and the Vice-Presidents in their functions. However, their number has expanded. Francesc Gòdia of the Autonomous University of Barcelona has also become a Vice-president. The old-new leadership will support EFB’s strategy for the next five years, at which the negotiators agreed,” Michaela Holecová from the Czech Regional Branch Office said.

The main purpose of EFB is the promotion of biotechnology in Europe. One of the topics discussed at the Barcelona meeting was also the need to change European legislation on genetically modified plants. “CRH’s leadership initiative to push for a change in European laws, which turned to Czech politicians including the Prime

Minister, was rewarded in this regard. There is a consensus at the EFB that there is a need to stimulate public debate, improve people’s awareness and reject many myths that are wrongly associated with GMOs,” Holecová added.

PROJECT SUPPORTED COOPERATION WITH EFB

Ministry of Education, Youth, and Sports financially supported the close cooperation of the European Federation of Biotechnology with Czech scientists through CRH, which is the national representative of the Czech Republic in this organization. Thanks to the project of INTER-VECTOR sub-program, Regional Branch Office representatives will be able to continue to participate in the development of a strategy for European research, agricultural policy and bio-economy, and to provide Czech research teams with greater awareness, involvement in international research cooperation and participation in congresses and other conferences organized by the EFB. An important part of the project lies not only in information and organizational activities oriented towards the scientific community, but also educational and popularization activities aimed at raising the awareness of biotechnology among the wider public. The project will last for two years and is subsidized by CZK 470,000.

PLANNED ACTIVITIES

G4G WITH NEW FEATURES IS COMING UP

At least two innovations will be brought about by the international conference Plant Biotechnology: Green for Good V, organized by CRH on June 10 - 13 at the Faculty of Science of Palacký University. Nils Stein, a plant geneticist of IPK Gatersleben and University in Göttingen, will be the keynote speaker. Next on the program will be Miltos Tsiantis of Max Planck Institute for research of plant breeding. In addition to lectures in seven scientific sections, the program will also include a workshop dedicated to the preparation of grants and expert publications, with speakers such as EFB Vice President Jeff Cole, Lynn Sherrer from Elsevier Publishing House, or ERC Grant holder Michal Otyepka from the partner Regional Center of Advanced Technologies and Materials (RCPTM). Both UP research centres will participate in Sustainable Environmental Technologies section with a chemist Rajender S. Varma as the main speaker. He



works in the US Environmental Protection Agency as well as RCPTM and has repeatedly featured on the list of Highly Cited Researchers. Like the year before, CRH is working with the US Department of Agriculture, which will, among other things, financially support the closing lecture delivered by a chemist Kyle Lancaster of Cornell University. The conference takes place in Olomouc every two years. Its aim is to inform about new trends in plant biotechnology, to enable young scientists in particular to present research results and to establish valuable contacts with colleagues. In case of interest, please register at <http://www.efbiotechnology.org/g4g>.



Centre of the Region Haná for Biotechnological and Agricultural Research

CRH brings together research groups from Palacký University and Olomouc worksites of Institute of Experimental Botany, AS CR, and Crop Research Institute. CRH is a Regional Branch Office of EFB.

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