NEWS FROM CRH

September 2019

CENTRE OF THE REGION HANÁ
FOR BIOTECHNOLOGICAL AND
AGRICULTURAL RESEARCH

INTERVIEW

ALEŠ PEČINKA

Plant Geneticist

He has been working for two years in the Olomouc laboratory of the Institute of Experimental Botany, Academy of Sciences of the Czech Republic, one of the units of CRH, where he moved after 16 years abroad. He is one of the leading experts in plant cell nucleus research and, as he says, the ambassadors of genetically engineered crops.

How do you assess the past two years?

More or less positively. We managed to create a stable team that works well. I would like to thank Jaroslav Doležel, head of the laboratory and scientific director of CRH, who enabled us to develop superbly. I also appreciate that we are part of CRH. I perceive the power of the campus in Holice in cooperation among people from different departments.

I very much like the synergy, I believe we have great potential to move plant research further. I think that today we are the main scientific center for molecular-genetic research of plants in the Czech Republic.

You came to Olomouc from Max Planck´s Institute, you say that working in Germany is a milestone in your scientific career. Is it even possible to move somewhere better from there?

Certainly it is, and I have succeeded to a certain extent. If I am to compare their environment with my current location, in terms of material equipment, the situation is comparable, in some respects even better. Not only the equipment itself, but also the stability and know-how of the people who operate it. While in Germany we all worked superficially on many devices, in Olomouc there is a different approach and colleagues are more specialized. What is missing in our conditions is about fifty years, when Max Planck's network of institutions went through different periods of development and gradually formed the rules, whereas CRH is basically a greenfield project, and the rules are still being formed.

There has been a discussion about the establishment of a new university institute at UP for months, in which not only the existing scientific centers of CRH, RCPTM and IMTM, but also IOCB and the University Hospital would cooperate. Do you support this intention?

If we were to join other colleagues from different disciplines within the new university institute, it would certainly help everyone. This is in line with my experience from abroad, where on the basis of regular interaction we gained inspiration between different fields. For example, we already have some contacts with IOCB, so there would be something to develop. I am sorry about the situation between the Faculty of Science and the science centers. The "digging of trenches" was absolutely unnecessary. Instead of seeing the potential of synergy, there has been a split that weakens both the centers and the faculty, and sheds a negative light on our entire campus.

What projects are you currently working on?

A key topic in our group is so-called Structural Maintenance of Chromosomes (SMC) proteins, which are protein complexes found in all eukaryotic organisms, i.e. plants, fungi, animals and humans. These complexes are essential for the organization and maintenance of chromosome structure. We focus mostly on the SMC5 / 6 complex, which controls the hitherto unknown way of DNA repair. This research is set within a framework where we try to characterize the functions of nuclear genes that are involved in the organization and management of the cell nucleus. We look at how the properties of the cell nucleus affect properties of plants. In this respect, our core theme is development of seeds, specifically their component - endosperm nutrient tissue. We are interested in how the endosperm develops both in the model plant of *Arabidopsis*, when the embryo eventually consumes the endosperm before germination, and in barley, where the seed is largely made up of endosperm and the embryo begins to consume it after germination. Cereal endosperm is the main ingredient of our food. Flour is produced from wheat endosperm, barley endosperm is important for malt production or as feed. In this case, we combine cell nucleus control with a particular trait that has significant breeding potential.

You are also devoted to promoting science and try to demolish myths about GMOs. European scientists have recently again called upon European politicians to change legislation on modern methods of plant genome editing. How important do you think this is?

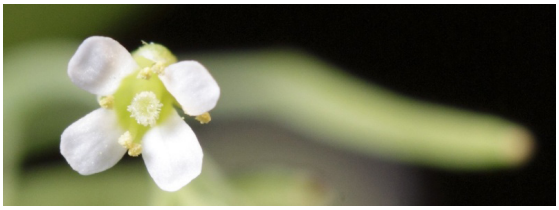
In my opinion, these practices will be essential for breeding of new varieties if we are to provide enough food for the world population, while not burdening the environment even more than now. We must also realize that there are countries much more progressive in this matter, such as the USA, Canada, China, and Japan will probably review its position very soon. This means that Europe will lose one large field of the economy with great added value. European innovations will not be competitive.

SCIENCE AND RESEARCH

TWO GENES OF ARABIDOPSIS NO LONGER CLASSIFIED AS "UNKNOWN"

Plant geneticists from the Olomouc laboratory of the Institute of Experimental Botany, Academy of Sciences of the Czech Republic (IEB AS CR) are the first in the world to describe the function of two genes of *Arabidopsis thaliana* and their influence on the properties of this model plant. The results were published by the prestigious Plant Cell journal.

The scientific group from the Center of Structural and Functional Genomics of Plants of IEB AS CR, which is a part of CRH, studied under the leadership of Aleš Pečinka one of three so-called SMC complexes involved in the chromosome deposition in the cell nucleus of *Arabidopsis*. This model plant has nearly 30,000 genes, which is more than in humans. For many of them scientists know their role, but others do not know much about it. This time, they have identified two previously unknown sister genes that were thought to be part of the SMC5 / 6 complex. The results of four-year work exceeded their expectations.



"We found out that one of the genes is able to correct errors in hereditary information. This is essential news, it means that it is crucial for plant life. It is extraordinary that it is also involved in the development of seeds, which could be used in practice in the future, namely when applying the latest biotechnological methods in breeding," Pečinka explained. The second gene, however, works differently, although they both originated by doubling a single gene about 30 million years ago. "Our research has ruled out that it is involved in correcting hereditary information. However, we suppose it is probably related to its copying," added the scientist. This research, which was launched at the Max Planck Institute in Cologne, Germany, was carried out in cooperation with other prestigious foreign institutions, such as the Tokyo University of Science and the University of Zurich.

Díaz M, Pečinková P, Nowicka A, Baroux C, Sakamoto T, Gandha PY, Jeřábková H, Matsunaga S, Grossniklaus U, Pečinka A (2019) The SMC5/6 complex subunit NSE4A is involved in DNA damage repair and seed development. Plant Cell 31, 1579-1597. IF = 8.631.

GREEN FOR GOOD V CONFERENCE WAS A SUCCESS

Approximately 150 participants of the international conference Plant Biotechnology: Green for Good V, organized by CRH in cooperation with the European Federation of Biotechnology in June were acquainted with new trends in the plant biotechnology, genetics, genomics and biochemistry of plants. According to representatives of both institutions, thanks to excellent lecturers, the conference has turned into a distinguished scientific event.

"Compared to the previous year, the quality of lectures has improved again, which is very gratifying. The topics gained great interest and stimulated discussion. We tried adding new program sections and it proved to be the right decision. We also received favorable response to the tour of our science center. Its prestige is growing," said the director of CRH and the main organizer of the conference Ivo Frébort.

Among the most important guests were the cereal genome sequencing expert Nils Stein from IPK Gatersleben and the University of Göttingen, who delivered the keynote speech; one of the directors of the Max Planck Institute for Plant Breeding Research in Cologne Miltos Tsiantis or Kyle Lancaster from the prestigious Cornell University in USA, whose participation in the conference was financially supported by the US Embassy in the Czech Republic.

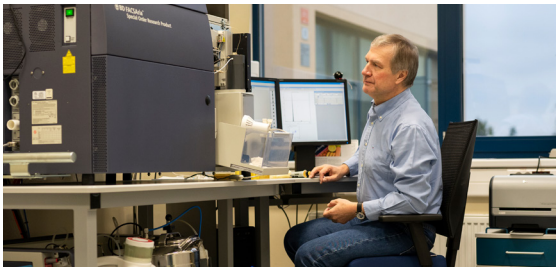
The conference was held under the auspices of Olomouc Region and with the support of Palacký University. There were 35 lectures and 86 posters presented throughout the conference. Experts discussed about biotechnology of agricultural crops, the relationship between plants and micro-organisms, genetics and genomics of plants, molecular farming and genetic engineering, possibilities to improve the quality of food and feed, or the relationship between plants and the environment. One of their tasks was to find ways to contribute to addressing major global challenges, including ensuring sufficient food for the ever-growing population. Another novelty was the Grant and Publication Workshop.

DECODING THE PEA GENOME WILL SPEED UP BREEDING OF NEW VARIETIES

Scientists from the Olomouc laboratory of the Institute of Experimental Botany, Academy of Sciences of the Czech Republic (IEB AS CR), which is part of the CRH, have achieved another success. Together with colleagues from abroad, they deciphered the hereditary information of common pea. The results of six-year work were presented in Nature Genetics.

Deciphering the pea genome, which is one-third larger than the human genome, will contribute to breeding new varieties and growing this important crop more extensively. "It will be possible to use the latest methods of molecular biology and biotechnology. Personally, I see certain symbolism in this work in connection with the legacy of the founder of genetics Johann Gregor Mendel, who studied in Olomouc and in Brno discovered the laws of inheritance thanks to the study of peas. I have no doubt that he would be very pleased with our work, and I hope that we have helped to make peas again a widespread crop," said Jaroslav Doležel, head of the laboratory and scientific director of CRH.

Laboratories from all over the world joined in the Pea Genome Consortium collaborated on the research. The project was coordinated by the French National Institute for Agricultural Research in Dijon. Olomouc scientists



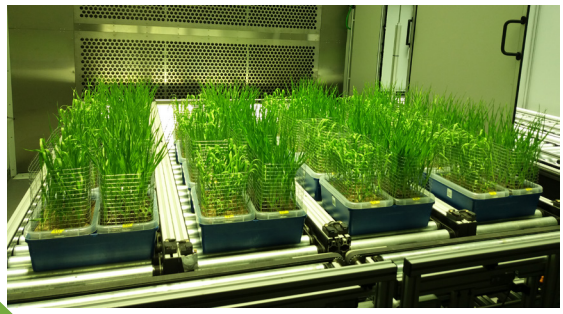
participated in two ways. Using unique genome optical mapping technologies and chromosome sorting, they have contributed significantly to improving the compiled text of hereditary information. The method of chromosome sorting was developed by this very laboratory in Olomouc and is still the only workplace in the world that routinely uses it. The same technology was used by experts to investigate the differences between the structure of hereditary information of cultivated peas and its wild relatives. They revealed how evolutionary pea information changed during evolution from a common ancestor existing 50 million years ago to today.

Kreplak J, Madoui M-A, Cápal P, Novák P, Labadie K, Aubert G, Bayer PE, Gali KK, Syme RA, Main D, Klein A, Bérard A, Vrbová I, Fournier C, d'Agata L, Belser C, Berrabah W, Toegelová H, Milec Z, Vrána J, Lee HT, Kougbeadjo A, Térézol M, Huneau C, Turo CJ, Mohellibi N, Neumann P, Falque M, Gallardo K, McGee R, Tar'an B, Bendahmane A, Aury JM, Batley J, Le Paslier MC, Ellis N, Warkentin TD, Coyne CJ, Salse J, Edwards D, Lichtenzveig D, Macas J, Doležel J, Wincker P, Burstin J (2019) A reference genome for pea provides insight into legume genome evolution. Nat. Genet 51, 1411-1422. IF = 25.455.

NEW METHOD WILL ALLOW EFFICIENT AND RAPID EVALUATION OF PLANT PHENOTYPE

The cooperation of several CRH departments has resulted in a new method for fast, gentle and simple evaluation of plant phenotype. It provides a much more efficient way to see how a plant can cope with stress, such as drought. The method can help breeders, researchers, but also in agrochemical industry when developing anti-stress substances.

The method combines elements of mass screening, image analysis and simple metabolite determination. The main monitored property is the height of the vegetation, which varies depending on the stress and the plant´s adaptation to it. At the same time, this property is closely related to the content of some biologically active substances in plants, especially certain polyamines, which then serve as markers of stress response. This can be used both in research to compare large numbers of transgenic lines as well as in breeding when it is necessary to quickly select stress-resistant lines.



Automated plant phenotyping systems allow rapid and non-invasive evaluation of plant properties. However, these methods are often based on analysis of the growth of plants grown in individual pots, which makes the results difficult for transferring into practice. CRH researchers have taken a different path to get as close as possible to real conditions. The method developed by them does not analyze individual plants, but whole populations of plants growing together in a small area. Scientists have verified the method on barley, but it can also be applied to other economically important crops.

Marchetti CF, Ugena L, Humplík JF, Polak M, Podlešáková K, Fürst T, De Diego N, Spichal L (2019) A novel image-based screening method to study water deficit response and recovery of barley populations using canopy dynamics phenotyping and simple metabolite profiling. Front. Plant. Sci, in press. IF= 4.106. DOI: 10.3389/fpls.2019.01252

SCIENTISTS AGAIN DEMAND A CHANGE IN EUROPEAN LEGISLATION ON EDITING PLANT GENOME

In July, Czech scientists joined their foreign colleagues and called on the European Parliament and the European Commission to amend the legislation on the application of modern methods of plant genome editing. They issued an open declaration exactly one year after the European Court of Justice (ECJ) ruled that plants obtained by these methods are genetically modified organisms (GMOs). Ivo Frébort, Director of the Center of the Region Haná and its scientific director Jaroslav Doležel, joined the appeal.

According to the signatories, the ECJ ruling means that even crops with the most minor modifications of the genome, which can also occur spontaneously in nature, are subject to restrictive European regulations, which practically prohibit such modifications. Leading biologists and researchers disagree with this and again point to the possible negative effects of the verdict. Representatives of CRH management, who had already asked the Prime Minister and other Czech politicians last December to support changes in European legislation in this area, do not want to stand by and watch.

According to both Prof. Frébort and Doležel, there is concern that the current situation may permanently harm European countries: "While there are increasing numbers of countries in the world that allow these modern technologies, Europe remains conserved. Every month, the gap between EU and progressive countries is increasing, which can have a very negative impact on European agriculture, food production and quality, as well as on the environment," both scientists agree.

CRH WILL CONTRIBUTE TO IMPROVING AIR IN OSTRAVA

CRH is involved in a European project called CLAIRO (CLean AIR in Ostrava). Its aim is to contribute to the improvement of the air in the northern Moravian regional city by planting suitable greenery, which will absorb dirt from various sources and reduce the effects of the so-called heat island in the city. The results will be used not only in Ostrava, but elsewhere in Europe.

The task of CRH scientists is to support the growth of vegetation by biostimulants. The trees will be exposed to many negative impacts of the local environment, and specially prepared substances will help them overcome these difficulties. Selected greenery will be planted under the supervision of Ostrava University in districts of Radvanice and Bartovice. The Technical University of Ostrava will then be in charge of evaluating the measured pollution values.

Research and development of plant hormone-derived growth regulators has been researched by the Department of Chemical Biology and Genetics of CRH for about two decades. "Thanks to many years of experience, we can prepare tailor-made stimulants for specific plant species and the conditions in which they are found. They can thus face such stress factors as drought, salinity or high heavy metal concentrations," said the head of department Karel Doležal. Along with his colleagues, he is also developing special plant hormone derivatives that help to save endangered plant species in South Africa.

Budget of the CLAIRO project is approximately CZK 65 million. The money will come from the prestigious Urban Innovative Actions program will support the most innovative projects in Europe. The project will last until 2022.

BRIEFLY

Lectures, practical demonstrations and experiments as well as play for children were prepared by CRH researchers for visitors to the summer stage of the Flora Olomouc flower exhibition. Together with molecular biologists, people could test DNA isolation from banana, examine onion cells under a microscope, and observe cell division. They also learned about the preparation of transgenic plants and new breeding methods. Experts from the Department of Chemical Biology and Genetics presented research on plant hormones and their use in agriculture. The weekend was directed by biophysicists, who passed on their knowledge of electrical signaling in plants, plant communication and their aging. They demonstrated the role of electric potential on popular flytraps. Representatives of the Olomouc workplace of the Crop Research Institute also took part in the event. Their exhibition received the Award of Olomouc Regional Governor. Experts focused in particular on pollination, insect pollinators and plant seeds. The IEB AS CR exhibition presented the latest results in plant research and breeding. It included an exhibition of large-format photographs by renowned Swiss photographer Mario del Curt, which outlined the work and legacy of Russian botanist and geneticist Nikolai Vavilov.

Experts on plant phenotyping included in the Czech Plant Phenotyping Network (CzPPN) met in August at a workshop entitled Integrating new methods of automated phenotyping in agriculture. CRH also had representatives at the meeting that took place in České Budějovice as part of the program of the "Earth the Bread-giver" and Plant Biology CS 2019 conference. Lukáš Spíchal from the Department of Chemical Biology and Genetics of CRH spoke about news from CzPPN, Jan Humplík from the same department shared his experience with the implementation of modern methods of remote scanning in the field trials at Palacký University. Petr Tarkowski from Crop Research Institute presented a lecture on Phenotyping as a tool for plant variety selection. CzPPN is a part of the European project ESFRI-EMPHASIS. There are 22 countries involved in the European network and CRH is the Czech national coordinator within CzPPN. The first annual CzPPN meeting took place in December 2017 in Olomouc.

A unique laboratory for DNA sequencing has been operating in CRH since June. It is dominated by the high-capacity DNA sequencer NovaSeq 6000 worth CZK 29 million, which CRH acquired through the Plants as a means of sustainable global development project. In addition, there are three more sequencers in the laboratory with different capacity, performance and sequencing systems. "In one place we managed to concentrate state-of-the-art technology, but also experts who have extensive experience with this work. We often carry out specialized analyses that it would not be possible to buy them elsewhere. The key is that we have experience with relatively sophisticated sample preparation. We are therefore interesting for many partners to whom we can offer these services," said the laboratory manager Jan Bartoš.

CONGRATULATIONS

MIROSLAV OVEČKA RECEIVED PROFESSORSHIP

Miroslav Ovečka from the Department of Cell Biology of CRH received a professor degree in Molecular and Cell biology in June. He was handed over the appointment decree by the Minister of Education, Robert Plaga, together with sixty other personalities in the Great Assembly Hall of Karolinum in Prague.

For more than 25 years, Professor Ovečka has devoted himself to plant biology, especially to the issues of polarity, morphogenesis, division and differentiation of plant cells. He studies these processes comprehensively, i.e. not only at the subcellular and cellular levels, but also at the level of tissues, organs and whole plants, including in relation to biotic and abiotic environmental factors.

"I am pleased to see that with the support of my colleagues I have achieved results that have significantly contributed to the expansion of knowledge in this area. Examples include the original characterization of endocytosis and root-hair recycling processes, a description of the processes of 'treating' plants after heavy metal stress has subsided, the discovery of plant defense responses to volatile substances that produce pathogenic microorganisms, introducing light-sheet microscopy in plant biology in the Czech Republic and innovative scanning of developmental processes not only in model plants but also in crops using this method," said Ovečka.

He considers obtaining the highest pedagogical and scientific rank as one of the most important milestones. The opportunity to work as a professor at Palacký University is a great honor and commitment for him. "My involvement in the preparation, start-up and teaching of a very prosperous Biotechnology and Gene Engineering study program at CRH contributed significantly to achieving professorship," he added. He has been working at Palacký University since 2012. His previous professional career was connected with the Institute of Botany of the Slovak Academy of Sciences and also with the Faculty of Science and Pharmacy of Comenius University in Bratislava. Long-term internships abroad in Austria and Spain also had a major influence on his scientific development.

NEWS FROM EFB

CRH HAD REPRESENTATIVES AT THE ASIAN CONGRESS ON BIOTECHNOLOGY

Not only sharing information and searching for new paths in the field of biotechnology, but also closer links between European and Asian science was the mission of the 14th Asian Congress on Biotechnology, which was held near Taipei in Taiwan in early July. Ivo Frébort, Director of CRH, as a member of the Executive Board of the European Federation of Biotechnology (EFB) took part in this event.

"It is important to link the two biotechnology worlds together. Asian science has advanced a lot, with many young emerging scientists, whose quality is rising significantly. We need to respond to this situation, share information and find new solutions to global problems together. We can find inspiration in Asia in many ways, for example, the system of transferring scientific resullts into practice is much more flexible," added Frébort, who was the only Czech invited speaker this year. Jitka Frébortová from the Department of Chemical Biology and Genetics of CRH also presented a lecture and Carlos Diaz from the Department of Molecular Biology of CRH took part in the poster section.

In 2014, the **European Federation of Biotechnology** concluded a Memorandum of Cooperation with the Asian Federation of Biotechnology. Since then, the cooperation has intensified, among other things, through mutual participation of the leaders of both federations at biotechnology biennale. This year, EFB was represented for the first time in Taiwan by President Mathias Uhlén and three vice-presidents.

PRESIDENT OF THE ASIAN FEDERATION OF BIOTECHNOLOGY DISCUSSED COOPERATION

Deepening the existing cooperation and establishing new contacts were the main objective of the visit of Wen-Chien Lee, President of the Asian Federation of Biotechnology (AFOB), to Palacký University and the Center of the Region Haná for Biotechnological and Agricultural Research (CRH), which is also the regional branch office of the European Federation of Biotechnology (EFB). One concrete step will be the preparation of a Memorandum of Cooperation.

"Palacký University excels in the field of biotechnology and agrarian research and I am delighted that we are visited by personalities such as the main representative of the AFOB. I know that thanks to Ivo Frébort, Director of CRH, and other scientists, contacts between the European and Asian Federations of Biotechnology are very rich and personal contacts are even more extensive. It is a sign that our university means something in the field of biotechnology. One of the results of the meeting is an agreement on the preparation of a memorandum between Palacký University, the Asian Federation of Biotechnology, and National Chung Cheng University, where Professor Lee works", said Rector Jaroslav Miller after Friday's meeting.

The scientist, who focuses mainly on protein isolation and purification, visited Olomouc for the first time. "I am pleased to have visited the University and the Center of the Region Haná, which focuses on plant biotechnology and is one of the best workplaces in its field. This area of research is of great importance in Asia, so we can look for topics for cooperation," said President of AFOB.

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.

Šlechtitelů 241/27
783 71, Olomouc – Holice

Tel: +420 585 634 979

Email: crh@upol.cz

Web: www.cr-hana.eu

Facebook: www.facebook.com/Centrumregionuhana/

Twitter: www.twitter.com/crh_olomouc

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