

DEPARTMENT OF PLANT PHYSIOLOGY

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PhD Students: Kristián Czibula, Viktor Demko, Zuzana Kuliková, Zuzana Kutarňová, Adriana Machlicová, Michal Martinka, Eva Šimonová, Andrej Pavlovič

Technical Staff: 6

Awards

Hudák Ján - Medal of Honor, Faculty of Natural Sciences, Charles University, Prague, 29th June, 2006, Bratislava

Lux Alexander - Medal of Honor, Faculty of Natural Sciences, Charles University, Prague, 29th June, 2006, Bratislava

Masarovičová Elena - Medal of Honor, Faculty of Natural Sciences, Charles University, Prague, 29th June, 2006, Bratislava

Martinka Michal - The Dean's Award of Faculty of Natural Science, Comenius University in Bratislava for lecture presentation of PhD students, November, 2006

Pavlovič Andrej - The Dean's Award of Faculty of Natural Science, Comenius University in Bratislava for lecture presentation of PhD students, November, 2006

Research and education projects

APVV-20-020805 - Expression of subunits of light independent protochlorophyllide oxidoreductase (DPOR) and chloroplast biogenesis regulation - J. Hudák, 2006 - 2009

VEGA 1/3272/06 - The role of cell wall extracellular matrix surface network and cytoskeleton in the process of somatic embryogenesis of plants - M. Bobák, 2006 - 2008

VEGA 1/3288/06 - The development of photosynthetic apparatus of selected gymnosperm species - J. Hudák, 2006 - 2008

VEGA 2/4146/24 - In vitro production of taxanes - effective cancerostatic compounds - D. Kákoniová, A. Lux, Ľ. Slováková, 2004 - 2006

VEGA 2/4145/24 - The involvement of cell wall galactoglucomannan-derived oligosaccharides in plant growth and developmental processes - D. Lišková, A. Lux, Ľ. Slováková, 2004 - 2006

COST Action 859 - Phytotechnologies to promote sustainable land use and improve food safety - A. Lux, 2004-2009

UK 204/2006 - The use of moss *Physcomitrella patens* in study of chlorophyll biosynthesis regulation - V. Demko, 2006

UK 155/2006 - The study of mustard (*Sinapis alba* L.) cotyledon regeneration after cycloheximide treatment - A. Machlicová, 2006

UK 239/2006 - Anatomical-cytological study of apoplastic barrier development decreasing transport of toxic metals - M. Martinka, 2006

UK 428/2006 - Anatomical, biochemical and physiological aspects of photosynthesis in carnivorous plants - A. Pavlovič, 2006

UK 199/2006 - Effect of cadmium on basic physiological processes and enzymes of oxidative stress of *Vigna radiata* and *Brassica juncea*. - E. Šimonová, 2006

Selected results

VEGA 2/4146/24 - In vitro production of taxanes - effective cancerostatic compounds - D. Kákoniová, A. Lux, Ľ. Slováková, 2004 – 2006

Selected monosaccharides and oligosaccharides (D-galactose, D-mannose and cellobiose) significantly increased the production, accumulation and secretion of taxanes, mainly of paclitaxel, the prime antitumoural substance in *Taxus baccata* L. suspension cultures. Paclitaxel content increased dependant on the elicitor used – various combinations and concentrations of saccharides in the culture medium, time, and the size of inoculum in suspension cultures. This suspension culture produced a significant content of paclitaxel, which was accumulated in cells and later during the culture, secreted into the culture medium. D-galactose (3%), D-mannose (3%) and cellobiose (3%) present in the culture medium had a positive impact on the production and secretion of paclitaxel in *Taxus* suspension cultures. The highest yield of paclitaxel was determined on the 42nd day of culture from 14-day old inoculum cultivated in a medium supplemented with 2% sucrose and 3% cellobiose.

A successful elicitation of secondary metabolites was also performed in *Rubia tinctorum* L. and *Melissa officinalis* L. suspension and callus cultures by the use of Cd(NO₃)₂ or CdCl₂.

VEGA 2/4145/24 - Involvement of cell wall galactoglucomannan-derived oligosaccharides in plant growth and developmental processes - D. Lišková, A. Lux, Ľ. Slováková, 2004 – 2006

GGMOs inhibition of plant elongation growth induced by auxins or gibberellin, is connected with changes in the activity of some enzymes (glycosidases, glycanases, XET) modifying physical and chemical properties of the plant cell wall. Their inhibition effect is probably also the result of cell wall thickening catalyzed by peroxidase. GGMOs affect the induction, growth, and structure of adventitious and lateral roots *in vivo* and *in vitro*, as well.

GGMOs increase cell population density and alter the protoxylem/metaxylem tracheary element (TE) ratio in xylogenic cell culture of zinnia. Poly- and oligosaccharides of mannan type were abundant in induced cells for TE differentiation. In non-induced cells these epitopes were very rare. These results indicate that mannans could act as signaling molecules naturally present in zinnia cells and could be included in the TE differentiation. Several genes were identified with rapidly modified transcript levels during the development of TEs in the presence of GGMOs. Most of them were down-regulated (e.g. zIAA8, providing that GGMOs may also interact with auxin-signaling pathways during *in vitro* TE formation, or genes connected with lignin formation). α -D-arabinofuranosidase, calmodulin-1, TED4-2, TED4-3, 60S ribosomal protein L41 were up-regulated, from which e.g. α -D-arabinofuranosidase could be involved in restructuring of the cell wall.

Foreign partners

COST Action 859 - Phytotechnologies to promote sustainable land use and improve food safety - A. Lux, 2004-2009

- Dr Martin R. Broadley, Plant Sciences Division, School of Biosciences, University of Nottingham, Sutton Bonington Campus, Loughborough, Leicestershire LE12 5RD, United Kingdom
- Professor Philip J. White, Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA, Scotland

Selected publications

Lišková, D. - Capek, P. - Kollárová, K. - Slováková, Ľudmila - Kákošová, A.: The Potential of Carbohydrates in Plant Growth Regulation. Floriculture, Ornamental and Plant Biotechnology. Advances and Topical Issues, Vol. 1. - London : Global Sciences Book, 2006. - p. 373-378

Šamaj, Jozef - Bobák, Milan - Blehová, Alžbeta - Preťová, Anna: Importance of Cytoskeleton and Cell Wall in Somatic Embryogenesis. - (Plant Cell Monographs ; Vol. 2). Somatic Embryogenesis. - Berlin, Heidelberg: Springer-Verlag, 2006. - p. 35-50.

Bukvayová, Nadežda - Henselová, Mária - Vajciková, Viera - Kormanová, Tatiana: Occurrence of dwarf virus of winter wheat and barley in several regions of Slovakia during the growing seasons 2001-2004. *Plant Soil and Environment*. - Vol. 52, No. 9 (2006), p. 392-401

Pavlovič, A. - Masarovičová, Elena - Kráľová, Katarína - Kubová, Jana: Response of chamomile plants (*Matricaria recutita* L.) to cadmium treatment. *Bulletin of Environmental Contamination and Toxicology*. - Vol. 77, No. 5 (2006), p. 763-771

Kráľová, Katarína - Masarovičová, Elena - Lešíková, Jana - Ondrejkočíková, I.: Effects of Cd(II) and Zn(II) Complexes with Bioactive Ligands on Some Photosynthesizing Organisms. *Chemical papers - Chemické zvesti*. - Vol. 60, No. 2 (2006), p. 149-153

Bobák, Milan - Šamaj, J. - Blehová, Alžbeta - Ovečka, M. - Hlavačka, A. - Illéš, P. - Kutarňová, Zuzana: A histological and SEM study of early stages of direct somatic embryogenesis in leaves of sundew *Drosera spathulata* Labill. *Acta botanica Hungarica*. - Vol. 48, No. 1-2 (2006), p. 29-38

Research highlights

Šamaj, J., Bobák, M., Blehová, A., Preťová A.: Importance of Cytoskeleton and Cell Wall in Somatic Embryogenesis, 35-50. In: A. Mujib., Šamaj, J. (eds.): *Plant Cell Monographs* (2). Somatic Embryogenesis. Springer-Verlag Berlin, Heidelberg, 2006

Cytoskeletons composed of microtubules and actin microfilaments as well as cell wall components such as arabinogalactan-proteins and pectins play a crucial role during somatic and zygotic embryogenesis in plants. These components control proper cell division and expansion during early embryogenesis and later during embryo differentiation. Here we discuss structural, physiological and functional aspects connected to the role of cytoskeleton and cell wall during embryogenesis in selected model species including carrot, maize, *Arabidopsis* and sunflower. Additionally, the signaling properties of cell wall components and cytoskeleton relevant for somatic embryogenesis are also discussed.

Lišková, D., Capek, P., Kollárová, K., Slováková, Ľ., Kákošová, A.: The Potential of Carbohydrates in Plant Growth Regulation. 373-377. In: *Floriculture, Ornamental and Plant Biotechnology. Advances and Topical Issues, Vol. I.* - London: Global Sciences Book, 2006

Endoglycanases, enzymes assumed to be involved in the elongation/cessation of growth showed remarkable activity changes after GMOs treatment indicating their role in cell wall remodeling and cell wall milieu stabilization during cessation of elongation growth. Studies on peroxidase showed that elongation growth inhibited by GMOs may be associated with the process of cell wall rigidification.

Martinka, M., Lux, A.: Intraspecific Variation of *Silene dioica* L. in Uptake and Translocation of Cadmium Related to Endodermal Development. 312-316. In: *Floriculture, Ornamental and Plant Biotechnology. Advances and Topical Issues, Vol. III.* - London: Global Sciences Book, 2006

Plants of different *Silene dioica* L. population can accumulate Cd to a very high concentration in their bodies. These plants, following treatment with a low Cd concentration develop appoplastic barriers close to the root tip thus reducing the transport of metals to the above-ground plant parts. The bioaccumulation coefficient of Cd is much higher in the plants originated from piles of old copper mines than in those from the vicinity of old mines.

International projects

COST Action 859 Phytotechnologies to promote sustainable land use and improve food safety

COST 859 is network of co-ordinated national research projects. Its aims are to:

- Understand and control the fate of pollutants in plants and food, non-food and technical crops.
- Optimise the remediation and controlling capacities of plants and thus make phytotechnologies more economically and socially attractive.
- Decrease the level and transfer of contaminants along the food chain.

- Specifically increase the content of essential minerals in food crops (fortified food).
It will enable significant progress to be made towards the sustainable use of land and water resources, the restoration of contaminated sites and the future supply of safe and fortified food.

Our contribution in 2006 was focused mainly on the relationship between structural characteristics of model species (*Arabidopsis thaliana*, *Silene dioica*, *Thlaspi caerulescens* and *T. arvense*) and their ability of uptake and translocation of toxic metals. Specifically the root apoplastic barriers – exo- and endodermis were studied. Additionally the alleviating effect of silicon on cadmium toxicity was studied in maize.

Theses (BSc.)

Daša Schnurmacherová: The comparison of somatic and zygotic embryogenesis of the Dicots. (Alžbeta Blehová*)

Natália Maximová: Cycloheximide and kinetin influence on oxidative stress and activity of some antioxidative enzymes (Ľudmila Slováková*)

Koloman Dienes: Comparison of photosynthesis and respiration and effect of Cd on these plant physiological processes. (Elena Masarovičová*)

Barbora Procházková: Structure and function of the root cap and roots of aquatic plants. (Alexander Lux*)

Theses (MSc.)

Zuzana Kuliková: Effect of selected saccharides on growth parameters and paclitaxel content in *Taxus baccata*L. cultures *in vitro*. (Daniela Kákoniová*)

Ľubica Halušková: Effect of cadmium on peroxidase activity in barley (*Hordeum vulgare*L.) roots. (Igor Mistrík*)

*supervisors