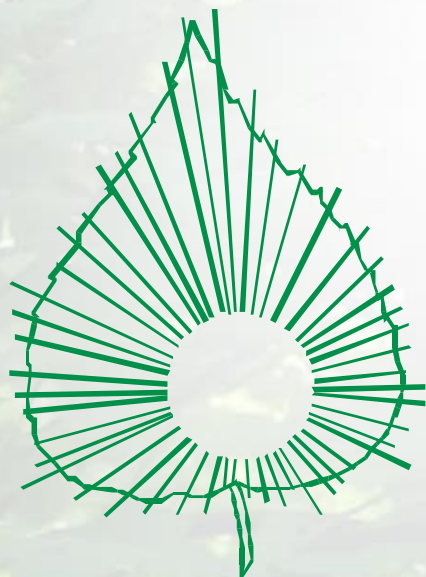




UMCS
WYDZIAŁ BIOLOGII I BIOTECHNOLOGII

Department of Plant Physiology and Biophysics



Head of the Department
prof. dr hab. Kazimierz Trębacz
kazimierz.trebacz@mail.umcs.pl



Supervisors of diploma theses (Bachelor's and Master's theses)



prof. dr hab.
Kazimierz Trębacz

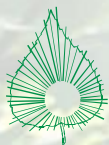
dr hab. Małgorzata
Wójcik, prof. UMCS

dr hab. Agnieszka
Hanaka, prof. UMCS

dr Mateusz Koselski

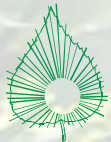
dr hab. Maria
Stolarz

dr Kamila Kupisz





- **Plant stress induced by abiotic stress factors, mainly heavy metals**
 - sensitivity of plants to metals in the environment
 - functioning of the photosynthetic apparatus under stress conditions
 - enzymatic and non-enzymatic antioxidant systems
 - role of signalling substances in the stress response of plants
 - intracellular mechanisms of metal detoxification and tolerance
 - comparison of metallophytic and reference plant populations
- **Biologically active substances in plants**
 - content and biological activity of secondary metabolites in plants
 - role of secondary metabolites in tolerance to abiotic and biotic stress factors
- **Molecular basis of electrical signals in plants**
 - bioelectrical responses of plants to environmental stimuli
 - membrane potential and action potential
 - ion channels - role in cell signalling and disease processes
- **Relation of electrical signals to plant movements**
 - circumnutations as endogenous plant movements
 - occurrence of spontaneous action potentials
 - role of circumnutations and action potentials in plant growth
 - ultradian and diurnal rhythmicity in the motor and electrical activity of plants



Plant material

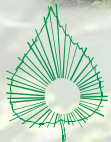


UMCS
WYDZIAŁ BIOLOGII I BIOTECHNOLOGII

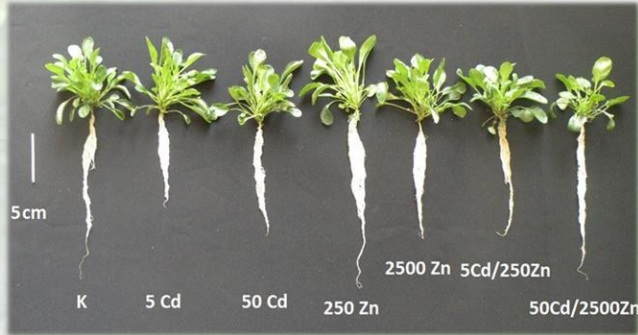
- **Plant species inhabiting waste heaps from zinc and lead ore mining and smelting in the vicinity of Olkusz and Upper Silesia (and their reference populations)**
(e.g. *Dianthus carthusianorum*, *Silene vulgaris*, *Echium vulgare*, *Daucus carota*)
- **Medicinal and herbal plants from the Lublin region**
- **Other higher plant species**
(e.g. *Phaseolus vulgaris*, *Zea mays*, *Helianthus annuus*, *Arabidopsis thaliana*, *Medicago truncatula*, *Vicia faba*, *Zea mays*, *Lupinus angustifolius*, *Mimosa pudica*)
- **Liverworts and bryophytes**
(e.g. *Conocephalum conicum*, *Marchantia polymorpha*, *Physcomitrella patens*)



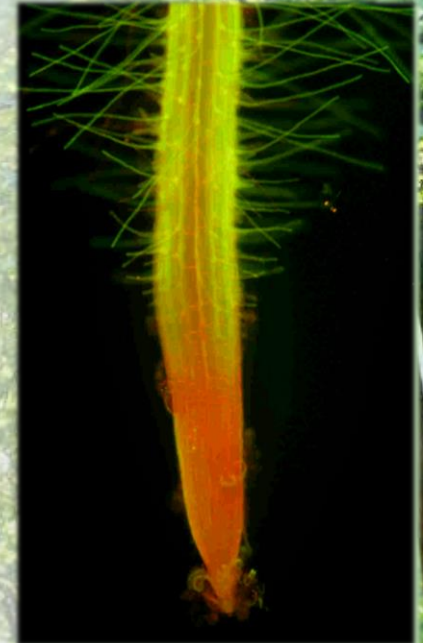
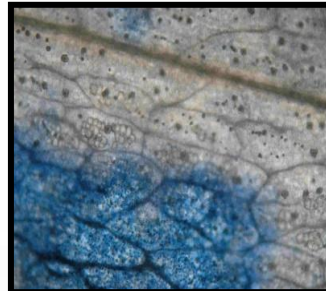
**We use plants collected from the field/nature
as well as grown indoors in vegetation chambers for the study**



Assessing the sensitivity of plants to metals

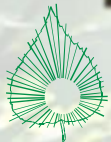


- morphometric parameters
- root and leaf cell viability
- accumulation of pigments and reactive oxygen species
- light and fluorescence microscopy, spectrophotometry

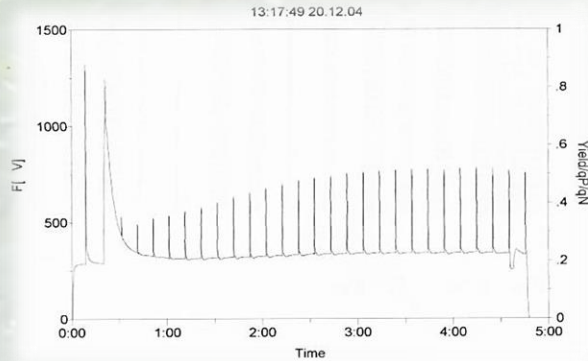


Persons involved: dr hab. Małgorzata Wójcik, dr hab. Agnieszka Hanaka

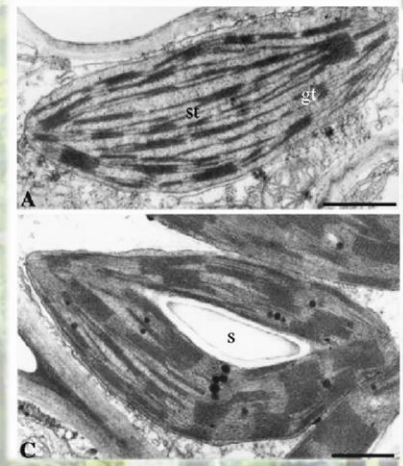
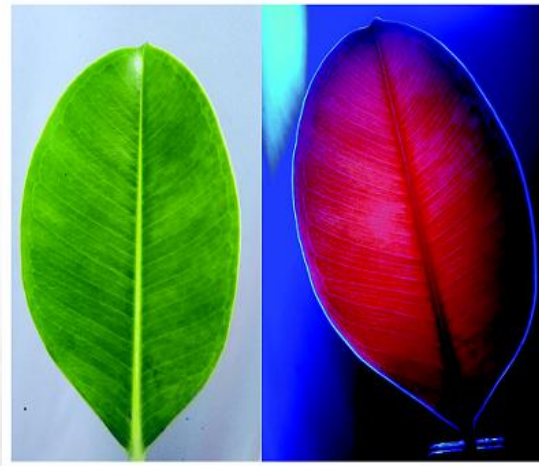
Department of Plant Physiology and Biophysics



Functioning of the photosynthetic apparatus

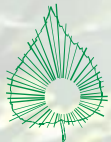


- photosynthetic pigments
- xanthophyll cycle
- chlorophyll a fluorescence
- structure and ultrastructure of chloroplasts
- *spectroscopy (UV-VIS, FTIR, circular dichroism), modulated chlorophyll fluorescence - PAM, electron microscopy*

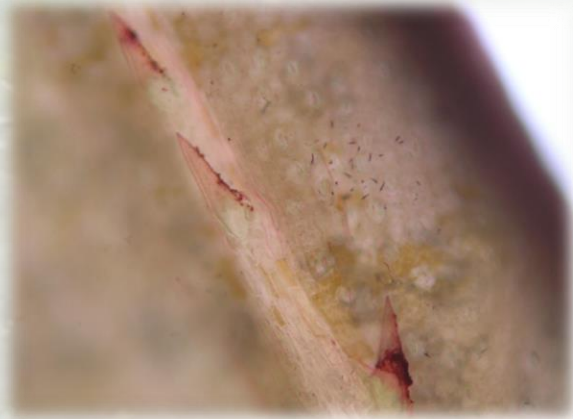


Persons involved: dr hab. Małgorzata Wójcik, dr hab. Agnieszka Hanaka

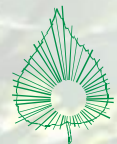
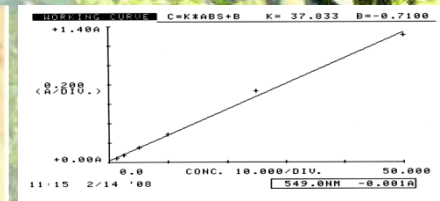
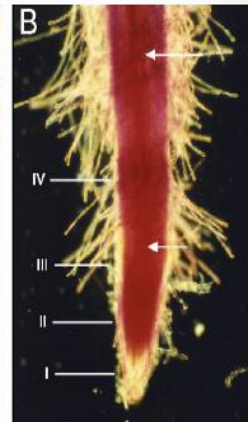
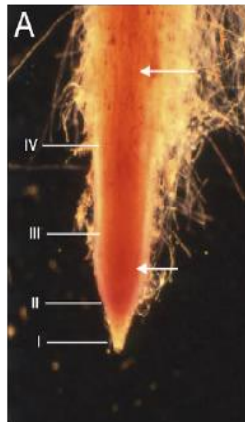
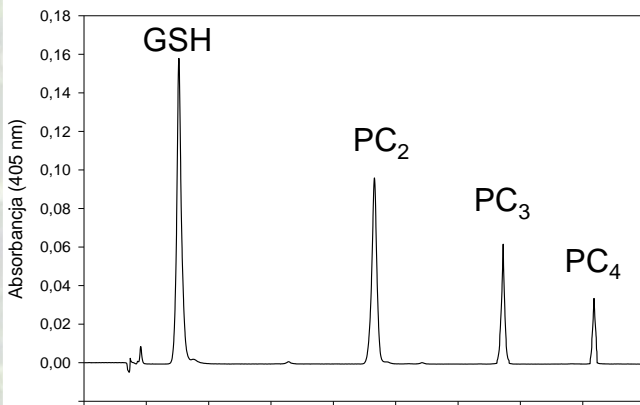
Department of Plant Physiology and Biophysics



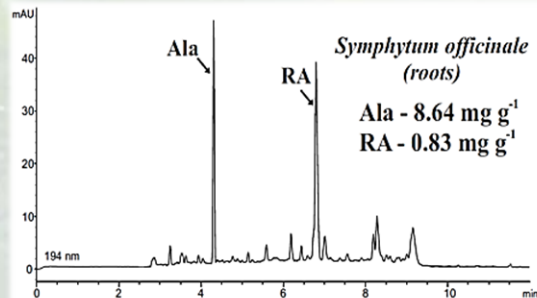
Mechanisms of metal detoxification and tolerance



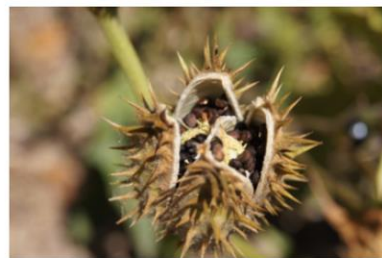
- low molecular weight organic acids (*HPCE*)
- primary and secondary metabolites (*spectroscopy, HPCE*)
- antioxidant system (*spectroscopy, light and fluorescence microscopy*)
- localisation and quantitative analysis of metals (*histochemical methods – microscopy, atomic absorption spectrometry – ASA*)



Secondary metabolites and biologically active substances in plants



- content of secondary metabolites in plants
- antioxidant properties of plant extracts
- metabolite profile under stress conditions
- *capillary electrophoresis (HPCE), spectrophotometry, thin-layer chromatography (TLC)*



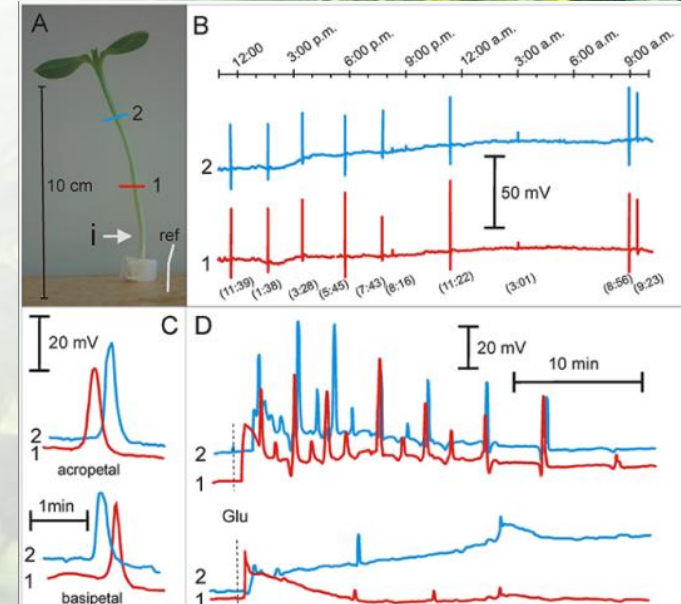
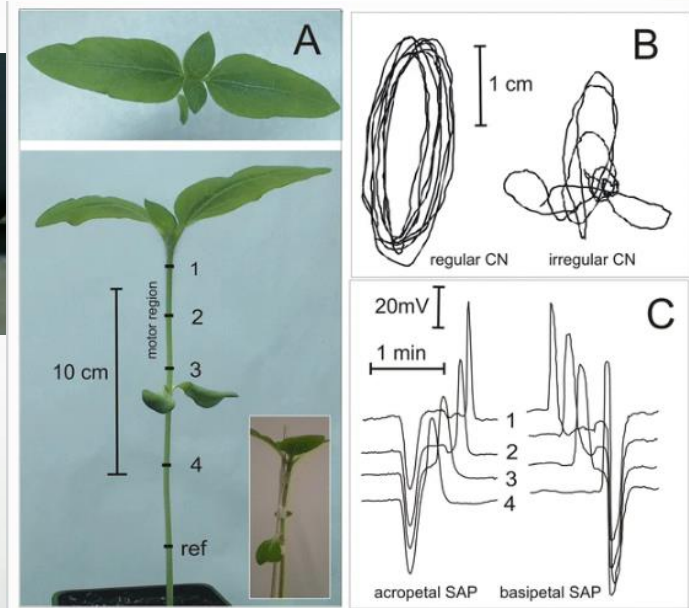
Persons involved: dr hab. Małgorzata Wójcik, dr hab. Agnieszka Hanaka

Department of Plant Physiology and Biophysics



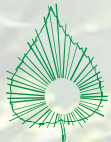
Ionic mechanism of action potentials and their role in plant physiological processes

- occurrence of induced and spontaneous action potentials
- study of the ionic mechanism of action potentials
- *method of extracellular electric potential recording*
- *method of intracellular electric potential recording - microelectrodes*

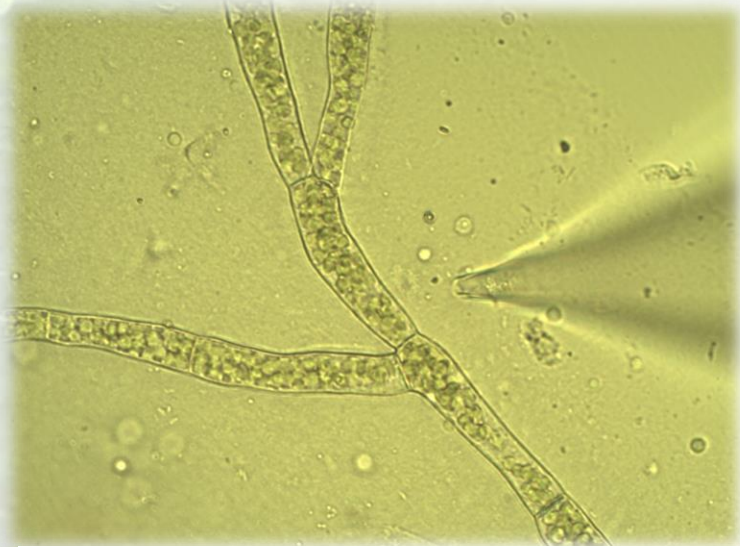


Persons involved: prof. dr hab. Kazimierz Trębacz, dr hab. Maria Stolarz, dr Mateusz Koselski

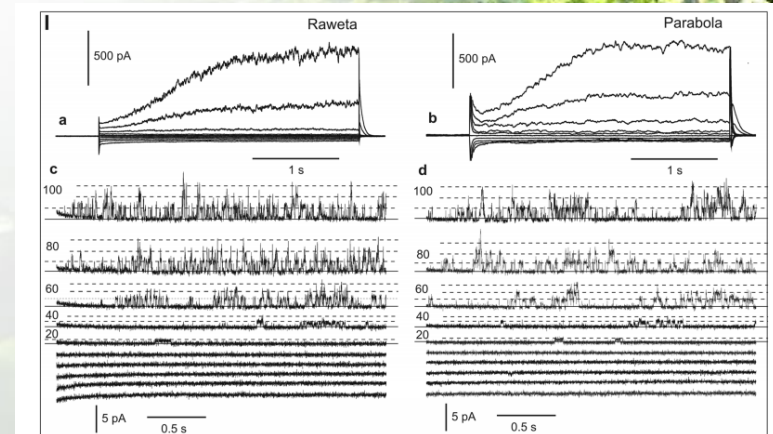
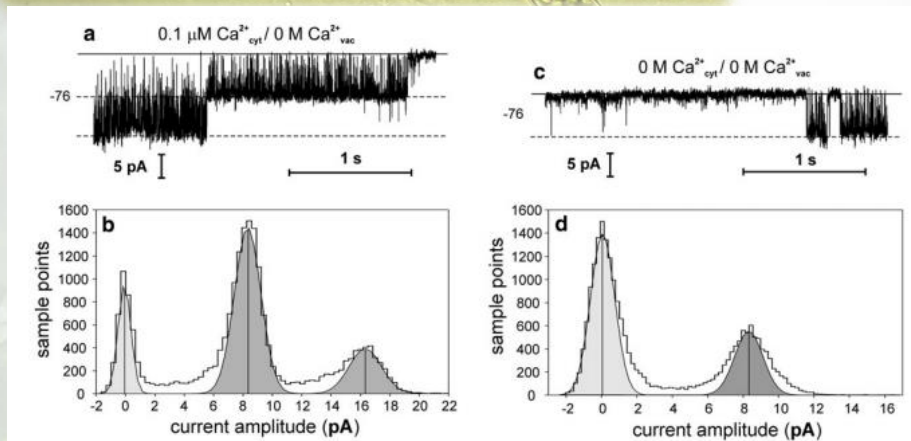
Department of Plant Physiology and Biophysics



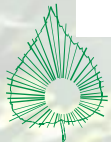
Determination of ion channel activity



- effect of active substances on the membrane potential studied by the *microelectrode method*
- *patch-clamp* study of ion channel activity



Persons involved: prof. dr hab. Kazimierz Trębacz, dr hab. Maria Stolarz, dr Mateusz Koselski



Circumnutation movements of plants

- role of circumnutation in plant growth and development
- ultradian and diurnal rhythmicity of plant movements
- *methodda time-lapse video* <http://circumnutation.umcs.lublin.pl>



Circumnutation

Home

Sunflower

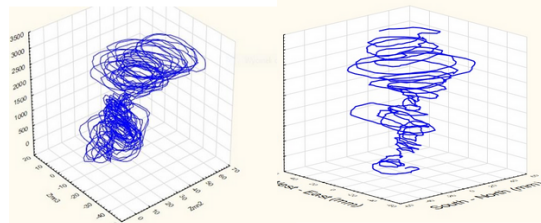
Plants

Circumnutation Tracker

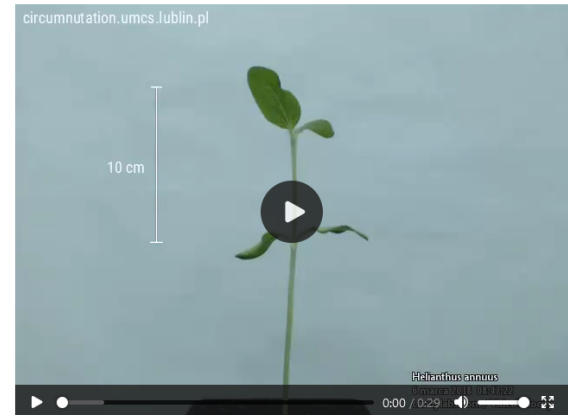
Literature

Home

Circumnutation (Latin *circus* for circle, *nutatio* for sway, CN) is an endogenous movement of plant organs such as hypocotyls, coleoptiles, epicotyls, stems, shoots, tendrils, petioles, or roots, the apex of which outlines a circle, ellipsis, pendulum-like shape, or irregular zigzags within a several minute- to several hour-long period. Due to organ elongation, series of a single trajectory of CN form a more or less regular helix.



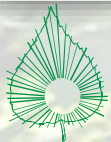
CN is a common phenomenon among plants but the knowledge of CN is not widespread. In our laboratory, CN have been registered and studied since 1993 mainly in *Helianthus annuus* plants but also in [Arabidopsis thaliana](#), [Tinantia anomala](#), [Lupinus angustifolius](#), [Medicago truncatula](#).



Film 1 Circumnutation of the stem of a three-week old sunflower. Time-lapse photography took three days in constant light conditions (1 frame per 5 min). The plant grew approx. 3.5 cm while doing 30 circumnutations (ca. 10 per day, one circumnutation has an average length of approx. 4 cm and takes approx. 145 minutes). **On average,**

Persons involved: prof. dr hab. Kazimierz Trębacz, dr hab. Maria Stolarz, dr Mateusz Koselski

Department of Plant Physiology and Biophysics



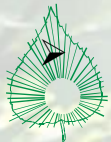
Examples of topics



Bachelor thesis

BSc theses are of a review nature, the topic of the thesis is established with the supervisor

- The use of *Chelidonium majus* L. in phytotherapy (Dr hab. S. Dresler)
- Review of plant species used in cosmetic industry (Dr hab. A. Hanaka)
- The role of vitamins in plant and human metabolism (Dr hab. M. Wójcik)
- Bioavailability of lutein (Dr E. Reszczyńska)
- Biofortification – a method for healthier food (Dr hab. M. Wójcik)
- Phytoestrogens – plant metabolites with multiple therapeutic effects (Dr hab. S. Dresler)
- Biopharmaceuticals – new drugs being an achievement of modern biotechnology (Dr hab. A. Hanaka)
- Characteristics of selected carotenoids in the aspect of human health (Dr E. Reszczyńska)
- Biotechnological significance of *Aspergillus* fungi (Dr M. Koselski)
- Biological clocks (Dr M. Stolarz)
- Characteristics of SV channels in plant cells (Dr M. Koselski)
- Osmosis in plants (Dr hab. M. Stolarz)
- The action of sound and its role in biological and physical processes in the human body (Dr K. Kupisz)
- Effect of ionising radiation on cancer cells (Dr K. Kupisz)
- Bioelectrical signals in the insectivorous plant *Aldrovanda vesiculosa* (Prof. K. Trębacz)



Examples of topics



Master thesis

MSc theses are experimental in nature, research problem is established with the supervisor

- **Electrical potential changes in *Lupinus angustifolius* (Dr M. Stolarz)**
- **The role of allantoin and urea in reducing cadmium toxicity in cucumber (Dr hab. S. Dresler)**
- **Effect of silver ions on growth and selected physiological parameters of *Carlina acaulis* (L.) (Dr hab. S. Dresler)**
- **Effect of light intensity on the pool of xanthophyll pigments in the photosynthetic apparatus of *Phaseolus coccineus* (Dr hab. M. Wójcik, Dr E. Reszczyńska)**
- **Effect of different zinc concentrations on biometric and physiological parameters of *Phaseolus coccineus* (Dr hab. A. Hanaka)**
- **Changes in membrane potential in *Physcomitrella patens* induced by glutamate (Dr M. Koselski)**
- **Changes of the electric potential in *Lupinus angustifolius* plants in relation to the nitrogen content in the medium (Dr hab. M. Stolarz)**
- **Effect of temperature on selected anatomical and cytological features and physiological parameters of leaves of *Oxyria digyna* L. (Dr hab. A. Hanaka)**
- **Oxidative stress intensity and levels of selected primary metabolites in metallophytic and non-metallophytic ecotypes of *Dianthus carthusianorum* in response to cadmium, lead and zinc excess stress (Dr hab. M. Wójcik)**
- **Modification of the response of *Phaseolus coccineus* under Cu excess stress by soil microorganisms (Dr hab. A. Hanaka)**
- **Comparative analysis of morphometric parameters and viability of *Dianthus carthusianorum* L. seeds from metal-polluted and metal-unpolluted sites (Dr hab. M. Wójcik)**

