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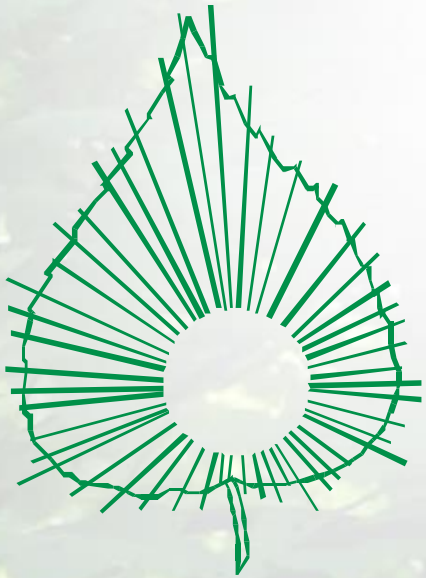
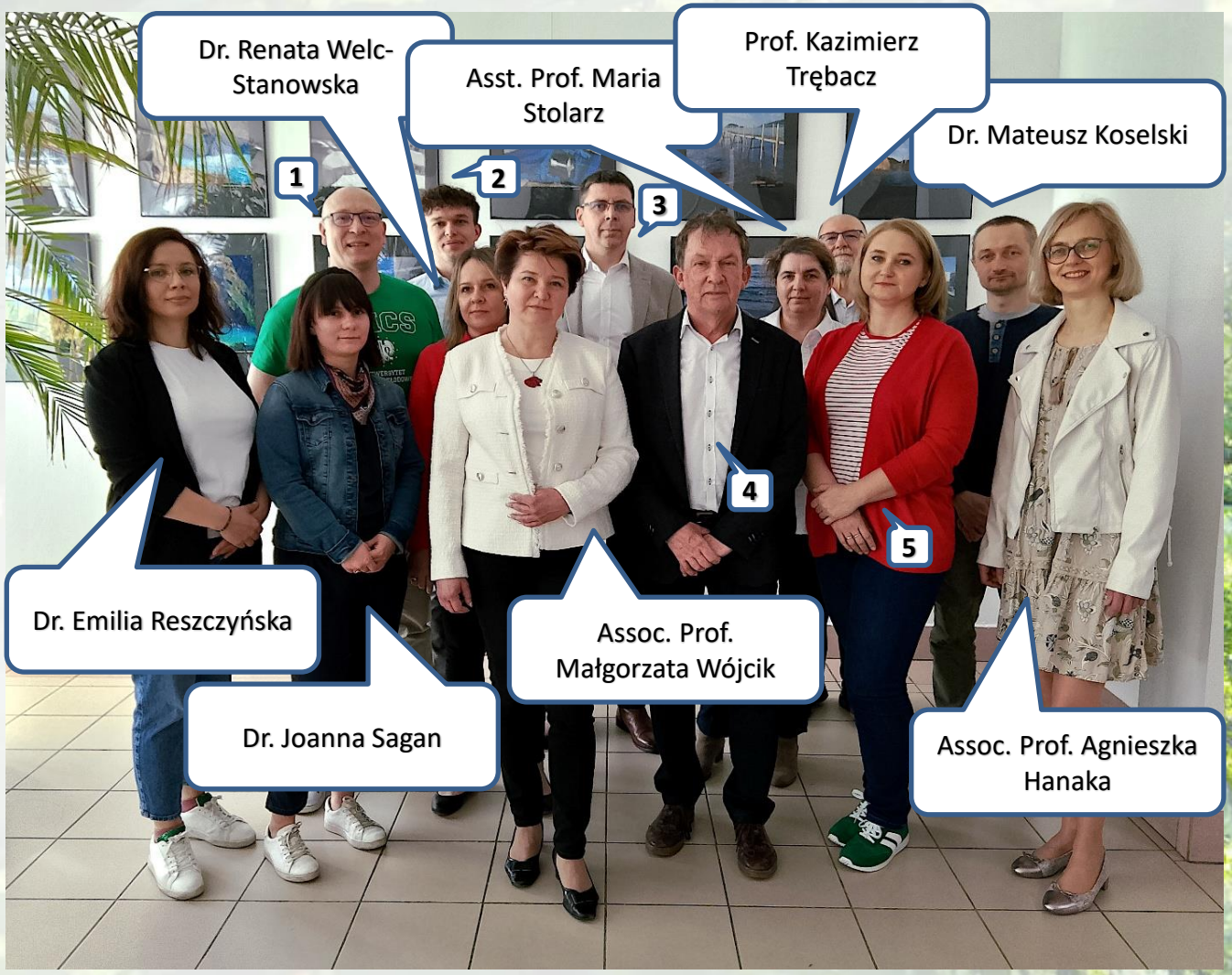
Department of Plant Physiology and Biophysics



Head of the Department
dr hab. Agnieszka Hanaka, prof. UMCS
agnieszka.hanaka@mail.umcs.pl

Supervisors of Master's and Bachelor's theses



Other staff: 1 – Dr. Piotr Waśko 2 – M.Sc. Dawid Świstak 3 – Prof. Sławomir Dresler
4 – Prof. Jaco Vangronsveld 5 – M.Sc. Elżbieta Koperwas

Research topics

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- **Plant stress caused by abiotic factors (heavy metals and temperature)**
  - sensitivity of plants to metals in the environment
  - activity of the photosynthetic apparatus under stress conditions
  - enzymatic and non-enzymatic antioxidant system
  - role of signal substances in the response of plants to stress
  - intracellular mechanisms of metal detoxification and tolerance
  - comparison of metallophytes and reference populations
- **Biologically active substances in plants**
  - content and biological activity of secondary metabolites in plants
  - role of secondary metabolites in metal and high temperature tolerance
- **Molecular mechanisms of electrical signals in plants**
  - bioelectrical responses of plants to environmental stimuli
  - membrane and action potential
  - ion channels – role in cell signaling and disease processes
- **Relationship between electrical signals and plant movements**
  - circumnutations as endogenous plant movements and plant behavior
  - occurrence of spontaneous action potentials
  - role of circumnutations and action potentials in plant growth
  - ultradian and circadian rhythms in the motor and electrical activity of plants

Plant material

- **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)**
- (np. *Dianthus carthusianorum, Silene vulgaris, Echium vulgare, Daucus carota*)
- **Medicinal and herbal plants from the Lublin region**
- **Other species of higher plants**
  (*Phaseolus vulgaris, Zea mays, Helianthus annuus, Arabidopsis thaliana, Medicago truncatula, Vicia faba, Zea mays, Lupinus angustifolius , Mimosa pudica)*
- **Liverworts and bryophytes**
  (*Conocephalum conicum, Marchantia polymorpha, Physcomitrella patens)*

We use field-grown and chamber-grown plants for research

Research Topics and Methods

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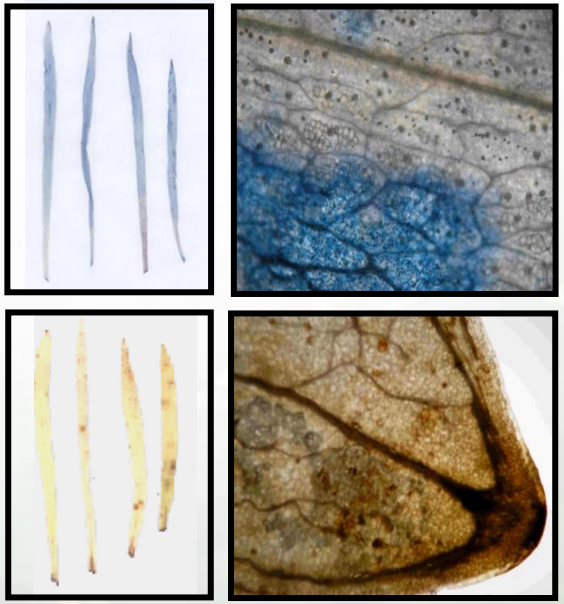
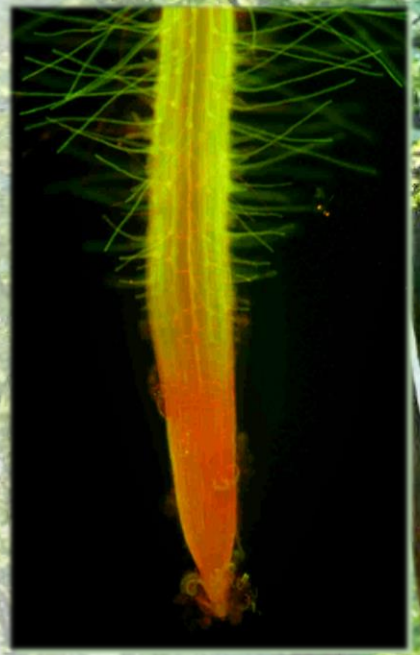
Assessment of plant sensitivity to metals

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





People involved in the topic: **Assoc. Prof. Małgorzata Wójcik, Assoc. Prof. Agnieszka Hanaka**

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Research Topics and Methods

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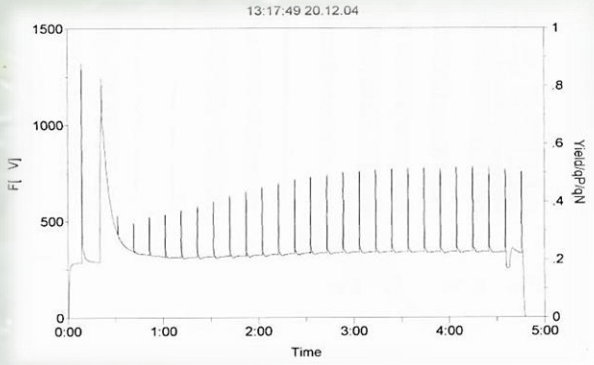
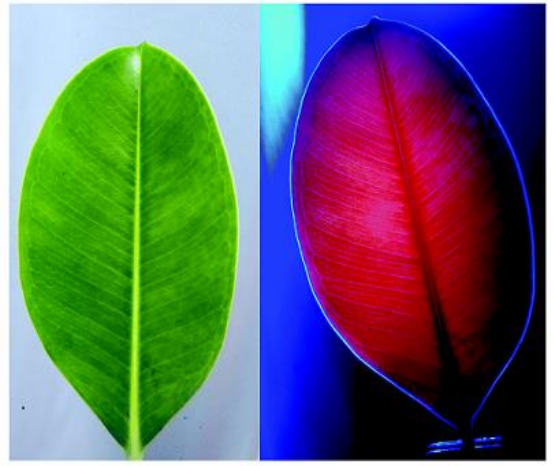
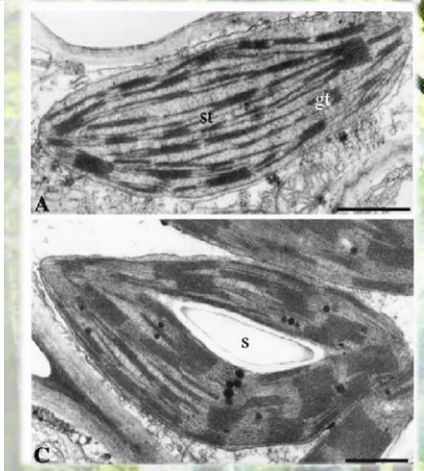
Operation of the photosynthetic apparatus



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





People involved in the topic: Assoc. Prof. Agnieszka Hanaka, Assoc. Prof. Małgorzata Wójcik, Dr. Emilia Reszczyńska, Dr. Renata Welc-Stanowska, Dr. Joanna Sagan

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Research Topics and Methods

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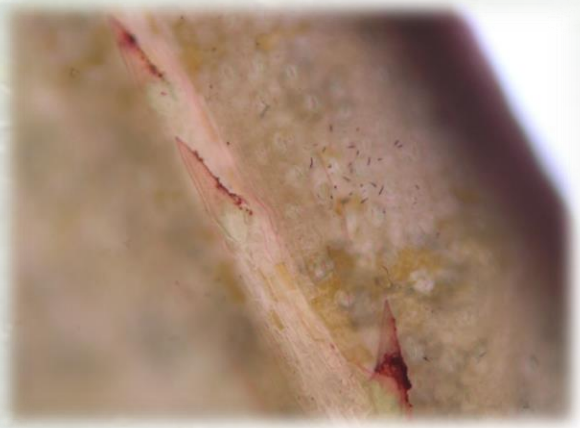
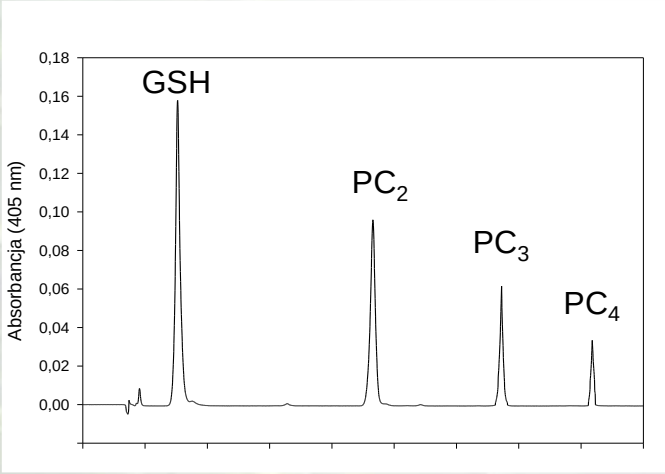
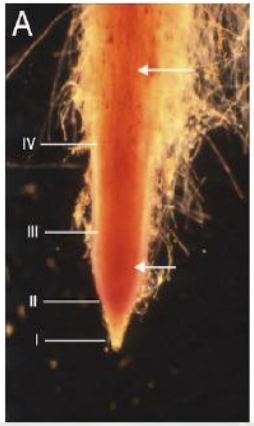
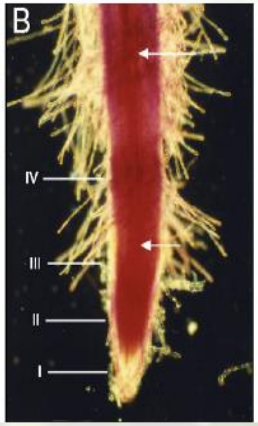
Mechanisms of detoxification and metal tolerance

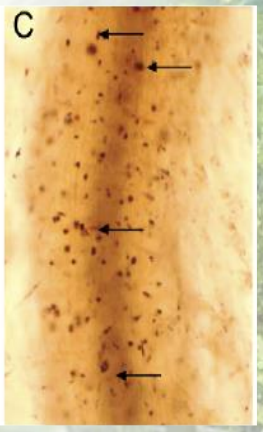


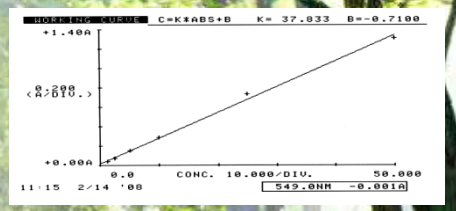
- accumulation of adaptive thiol peptides (phytochelatin) *(HPLC)*
- low molecular weight organic acids *(HPCE)*
- secondary metabolites*(HPCE)*
- Antioxidant system *(spectroscopy, light and fluorescence microscopy)*
- location and quantitative analysis of metals *(histochemical methods – microscopy, atomic absorption spectrometry – ASA)*











People involved in the topic : Assoc. Prof. Małgorzata Wójcik, Assoc. Prof. Agnieszka Hanaka, Prof. Sławomir Dresler

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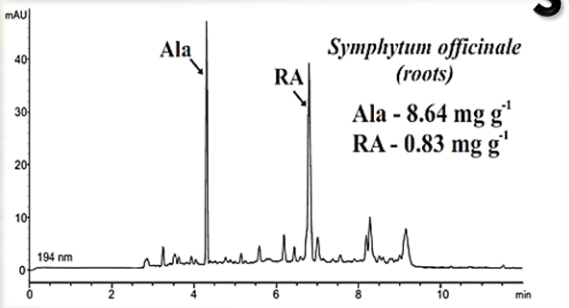
Secondary metabolites and biologically active substances in plants



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

People involved in the topic : Assoc. Prof. Agnieszka Hanaka, Assoc. Prof. Małgorzata Wójcik, Prof. Sławomir Dresler
Dr. Emilia Reszczyńska, Dr. Joanna Sagan, Dr. Renata Welc-Stanowska

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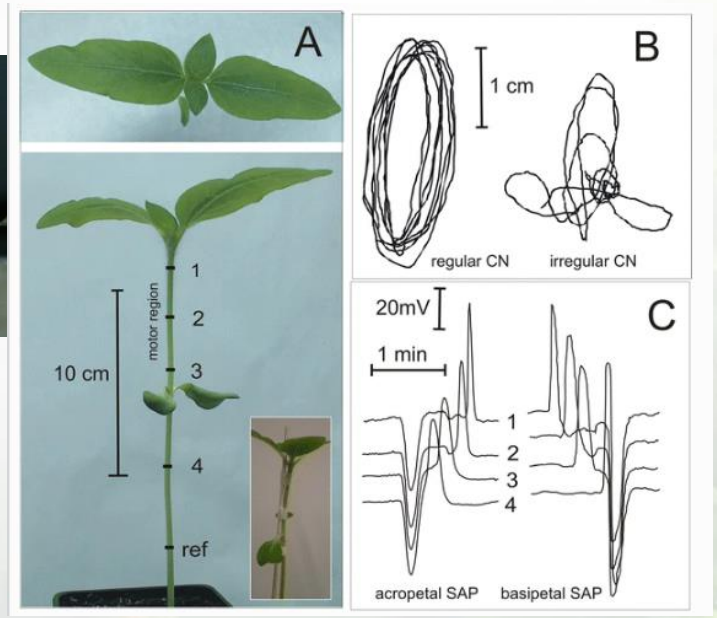
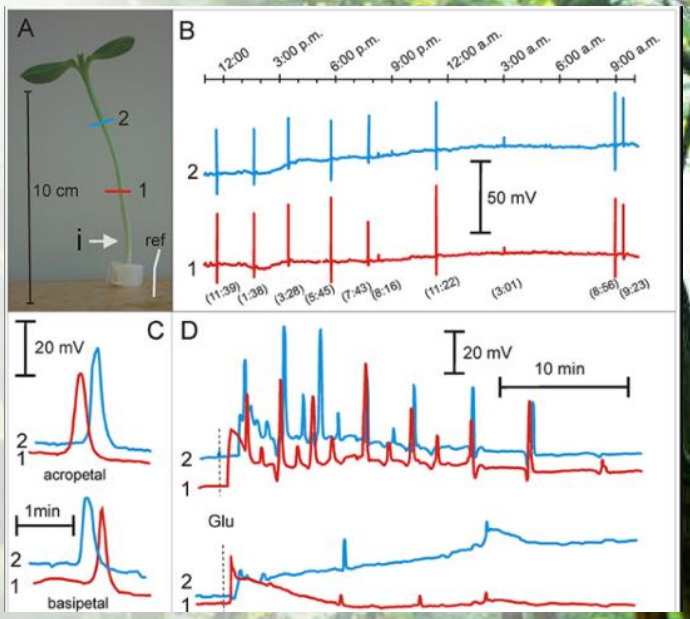
The ionic mechanism of action potentials and their role in plant physiological processes

- induced and spontaneous action potentials
- study of the ionic mechanism of action potentials
- *extracellular recording of spontaneous action potentials*
- *intracellular recording of spontaneous action potentials – microelectrodes*





People involved in the topic : **Prof. Kazimierz Trębacz, Asst. Prof. Maria Stolarz, Dr. Mateusz Koselski, Dr. Renata Welc-Stanowska**

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Research Topics and Methods

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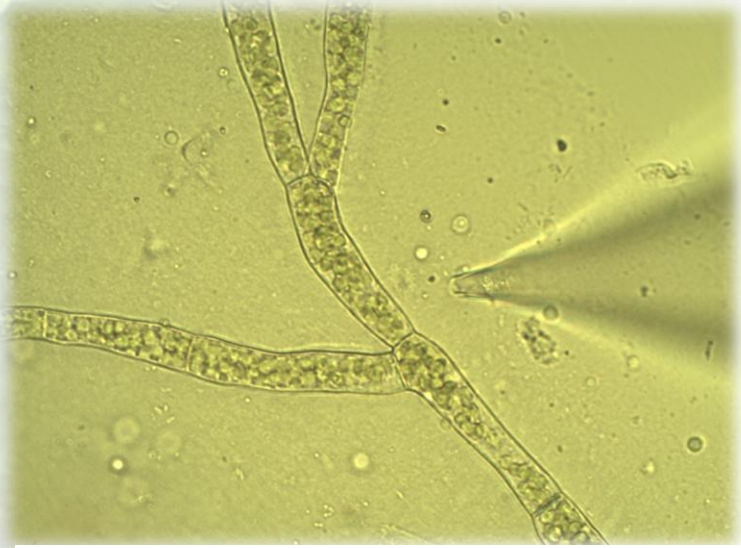
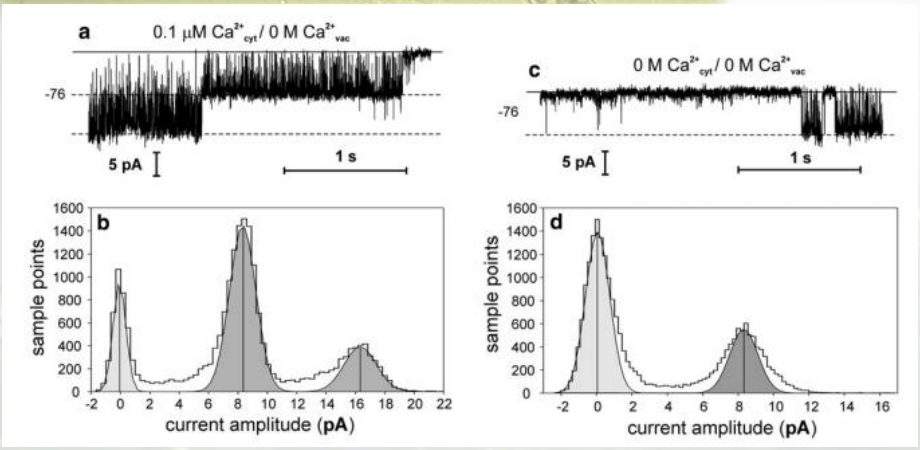
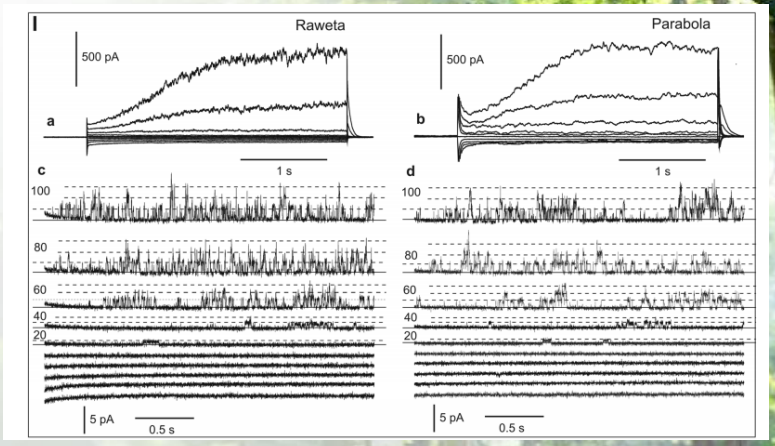
Ion channels activity



- the influence of active substances on the membrane potential
- *microelectrode method*

- ion channels activity
- *patch-clamp technique*





People involved in the topic : Prof. Kazimierz Trębacz, Dr. Mateusz Koselski

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Research Topics and Methods

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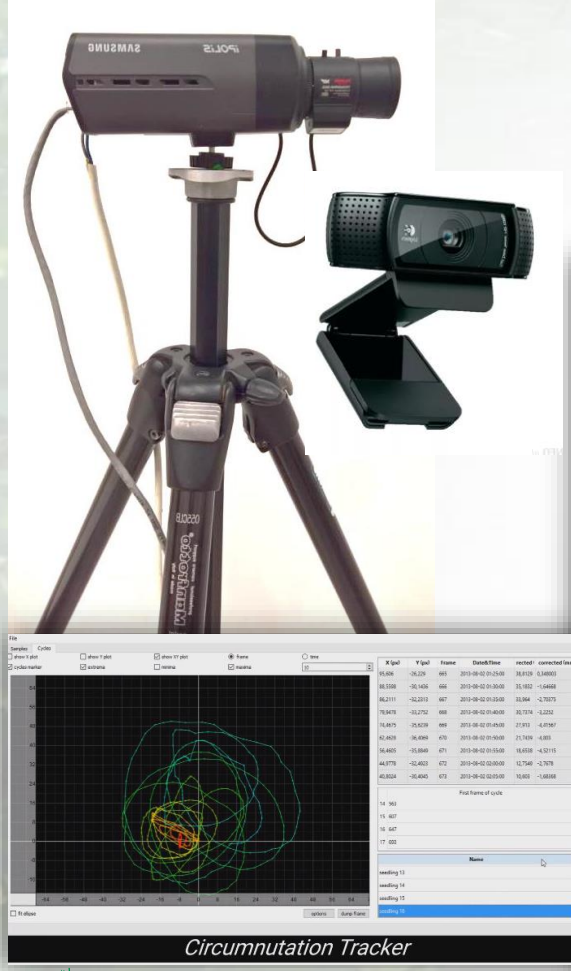
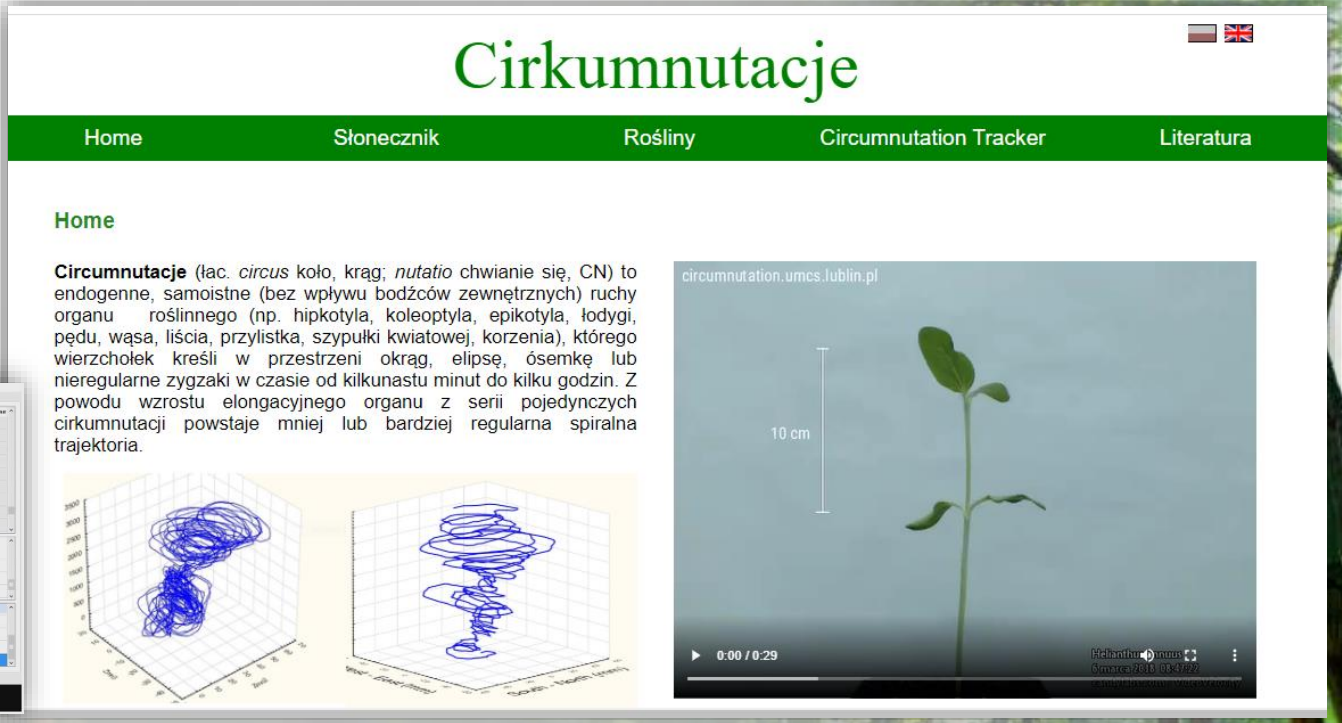
Circumnutational movements of plants



- the role of circumnutation in plant growth and development
- ultradian and circadian rhythm of plant movements
- *time-lapse method*
  http://circumnutation.umcs.lublin.pl



People involved in the topic : Asst. Prof. Maria Stolarz, Prof. Kazimierz Trębacz

Department of Plant Physiology and Biophysics

Examples of Bachelor`s theses

Bachelor's theses are of a review nature, the topic of the thesis to be agreed with the supervisor

- **Characteristics of forest trees and shrubs diseases caused by pathogens from Fungi kingdom (Asst. Prof. M. Stolarz)**
- **Application of bacteria *Escherichia coli* in biotechnology (Dr. M. Koselski)**
- **Overview of plant species used in the cosmetics industry (Assoc. Prof. A. Hanaka)**
- **The role of vitamins in plant and human metabolism (Assoc. Prof. M. Wójcik)**
- **Biofortification - a method for healthier food (Assoc. Prof. M. Wójcik)**
- **Biopharmaceuticals - new drugs as the achievement of modern biotechnology (Assoc. Prof. A. Hanaka)**
- **Biotechnological importance of fungi from *Aspergillus* family (Dr. M. Koselski)**
- **Biological clocks (Asst. Prof. M. Stolarz)**
- **Characterization of SV channels in plant cells (Dr. M. Koselski)**
- **Osmosis in plants (Asst. Prof. M. Stolarz)**
- **Bioelectric signals in insectivorous plant – *Aldrovanda vesiculosa* (Prof. K. Trębacz)**

Examples of Master`s theses

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Master's theses are of an experimental nature, the research problem set with the supervisor

- **The effect of TPC-type ion channel inhibitors as potential pharmaceuticals on the bioelectric activity of *Marchantia polymorpha* (Prof. K. Trębacz)**
- **The effect of biostimulants on the growth and level of stress metabolites in hemp (*Cannabis sativa* L.) grown in soil contaminated with metals (Assoc. Prof. M. Wójcik)**
- **Obtaining *Borago officinalis* L. extracts and their biological activity (Assoc. Prof. A. Hanaka)**
- **Changes of electrical potential in *Lupinus angustifolius* (Asst. Prof. M. Stolarz)**
- **The effect of different zinc concentrations on biometric and physiological parameters of *Phaseolus coccineus* (Assoc. Prof. A. Hanaka)**
- **Glutamate-induced changes of membrane potential in *Physcomitrella patens* (Dr. M. Koselski)**
- **Changes in the electrical potential of *Lupinus angustifolius* plants depending on the nitrogen content in the medium (Asst. Prof. M. Stolarz)**
- **The influence of temperature on selected anatomical and cytological features and physiological parameters of *Oxyria digyna* leaves (Assoc. Prof. A. Hanaka)**
- **Oxidative stress intensity and the level of selected primary metabolites in metallophytic and non-metallophytic ecotypes of *Dianthus carthusianorum* in response to stress induced by cadmium, lead and excess zinc (Assoc. Prof. M. Wójcik)**
- **Comparative analysis of morphometric parameters and viability of *Dianthus carthusianorum* L. seeds from metal-polluted and non-polluted areas (Assoc. Prof. M. Wójcik)**