

Subject Area: Advanced Methods in Biotechnology and Biodiversity

Subject: Biophysical aspects of plant growth and development

Level: PhD

Year: I-IV

Semester: 1-2

Speciality: N/A

Status: Facultative

ECTS: 3

Department(s): Department of Biophysics and Morphogenesis of Plants

Cooperating Department: N/A

Form of teaching (Number of hours; Form of assessment: Exam or Credit)

Lectures

Seminars/Conversatoria

Practicals

Total

30

30

Staff:

SUBJECT COORDINATOR: Jerzy Nakielski Ph.D.

LECTURE/CONVERSATORIA: Jerzy Nakielski Ph.D., Prof. Dorota Kwiatkowska Ph.D.

PRACTICALS: Dorota Borowska-Wykręt Ph.D., Prof. Dorota Kwiatkowska Ph.D., Jerzy Nakielski Ph.D., Joanna Szymanowska-Pułka Ph.D.

Contents:

LECTURES:

Unique features of growth of plant organs: symplastic growth, growth anisotropy, continuum condition, tensor of growth rates, frequency of cell divisions in relation to growth rates

Biomechanics of plant organ growth: growth as an irreversible deformation of cell wall, anisotropy of mechanical stress in cell walls, tissue stresses, stress and cellular pattern formation

PRACTICALS:

Empirical methods of growth quantification: methods of in vivo observation of organ growth, computation of growth variables on the basis of empirical data

Models of plant organ growth and morphogenesis: simulation of growth and cell divisions in apical meristems of root and shoot, formation of lateral roots and leaf primordia

Mechanical properties of plant tissues: turgor pressure and cell wall extension, the stress-strain relationship, rheological parameters measurements, viscoelastic models, mechanical resistance resulting from external forces acting on the growing organ

Methods and forms of teaching:

During lectures (powerpoint presentations) theoretical background for the practical part will be presented. Practical course will allow participants to carry on short projects on plant growth assessment, assessment of mechanical properties of plant tissues, or modelling of plant organ growth.

Requirements:

Literature (maximum 5, preferably recent sources, all in English):

1. Fleming A. (2006) The co-ordination of cell division, differentiation and morphogenesis in the shoot apical meristem: a perspective. **Journal of Experimental Botany** 57: 25–32.
2. Müller R, Borghi L, Kwiatkowska D, Laufs P, and Simon R. (2006) Dynamic and
3. Compensatory Responses of *Arabidopsis* Shoot and Floral Meristems to *CLV3* Signaling. **Plant Cell** 18: 1188-1198.
4. Nakielski J. (2008) The tensor-based model for growth and cell divisions of the root apex. I. The significance of principal directions. **Planta** 228: 179-189
5. Nakielski J, Hejnowicz Z. (2003) The description of growth of plant organs: a continuous approach based on the growth tensor. In: Nation J *et al* (eds) **Formal description of developing systems**. Kluwer Academic Publishers, Dordrecht, NATO science series II, 121: 119-136.

Remarks (if necessary):