“Functioning of plant genomes in relation to the environment” – part II		
International Doctoral Studies **Institute of Plant Genetics PAS**	**dr hab. Lidia Błaszczyk** Coordinator	**Tutors: scientists from the Institute of Plant Genetics, Polish Academy of Sciences**

General information:

Number / form (s) / type (s) of classes	A series of lectures, 15 didactic hours + 5 practical activities (supervised by lecturers)
Didactic cycle	Winter - Spring 2022
Language	English
ECTS credits	2

Objective of the course: Expanding knowledge on plant evolutionary and ecological genomics.

Topics:

1. **Plant resistance to biotic stresses** – 3 h lecture + 1 h practical activities;
   Prof. dr hab. Małgorzata Jędryczka;
2. **Flexibility of *Fusarium* plant pathogens and their interactions with host organisms** – 3 h lecture +1 h practical activities;
   prof. dr hab. Łukasz Stępień;
3. **Plant phenomics** – 3 h lecture + 1 h practical activities;
   dr hab. Anetta Kuczyńska, prof. IPG PAS;
4. **Plant partners and pathogens - next-generation sequencing and phylogenomics of eukaryotic microorganisms** – 3 h lecture + 1 h Q&A session;
   dr hab. Grzegorz Koczyk;
5. **Plant developmental responses to stress** – 3 h lecture + 1 h practical activities;
   dr hab. Robert Malinowski, prof. IPG PAS.

Effects of the course (in terms of knowledge, skills)

1. Plant resistance to biotic stresses – PhD student will:

a) name main pests and diseases of crop plants and recognise their economic importance,
b) understand the diversity of pathogen habitats,
c) can detect, subculture and identify various plant pathogens,
d) know modes of action of different plant pathogens,
e) understand the mechanisms of plant resistance to biotic stresses.

2. Flexibility of *Fusarium* plant pathogens and their interactions with host organisms – PhD student will:

a) know main groups of *Fusarium* species infecting crops worldwide,

b) list basic mycotoxins produced by these pathogens,
c) explain possible routes of infection and environmental factors responsible for successful plant tissue colonization,
d) hypothesize the course of the infection – name pathogen effectors and plant defense mechanisms triggered by them.

3. **Plant phenomics** – PhD student will:

a) understand what phenomics is and how it connects with other science domains,
b) get insight into the research that advance different aspects of plant phenotyping from the cell to the plant population levels,
c) get knowledge about the challenges and prospects of crop phenomics for precise breeding,
d) know the latest technologies in plant phenotyping.

4. **Plant partners and pathogens - next-generation sequencing and phylogenomics of eukaryotic microorganisms** – PhD student will:

a) be familiar with different sequencing techniques and understand their relative drawbacks,
b) be familiar with basic methods of phylogenetic reconstruction and understand differences between them,
c) understand the division into core fungal lineages in context of their evolutionary history (main differences, time periods),
d) know major groups of fungal secondary metabolites and be able to give examples of fungal adaptations to pathogenesis.

5. **Plant developmental responses to stress** – PhD student will:

a) get knowledge of plant developmental plasticity,
b) get knowledge on basic molecular pathways and cellular processes involved in plant developmental response to unfavourable conditions,
c) understand how pathogens can hijack plant development to acquire nutrients and build efficient physiological sink,
d) understand how adverse external conditions or pathogen attack influence plant growth,
e) understand how plant is managing C and N cost to gain the most appropriate response to stress,
f) get acquainted with newest findings published in the area of plant developmental plasticity.

Course content:

1. **Plant resistance to biotic stresses**:

a) diversity of pathogens and their habitats,
b) effect of pathogens on plant yield in Poland and worldwide,
c) methods of pathogen detection from plants, soil, water and air,
d) classical and molecular methods of pathogen identification,
e) quantification of disease symptoms,
f) modes of action of different pathogens,
g) mechanisms of plant response to biotic stresses,
h) structure of avirulence genes and resistance genes.

2. **Flexibility of *Fusarium* plant pathogens and their interactions with host organisms**:

a) *Fusarium* populations and their hosts: inoculum sources, infection process, plant diseases caused,

b) fungal secondary metabolism and molecular communication with the host,

c) signaling pathways and defense mechanisms,

d) experimental models used in *Fusarium* research.

3. **Plant phenomics:**

a) what is phenomics,

b) phenomics in scientific research,

c) plant phenotyping technologies.

4. **Plant partners and pathogens - next-generation sequencing and phylogenomics of eukaryotic microorganisms**:

a) sequencing methods in studies of eukaryotic microorganisms (with particular emphasis on next-generation methods),

b) basic methods and pitfalls of phylogenetic and phylogenomic reconstructions,

c) evolutionary history of eukaryotic microorganisms and origins of both higher and early-diverging fungi - current state of knowledge,

d) genesis of fungal adaptations to pathogenesis and biosynthesis of secondary metabolites.

5. **Plant developmental responses to stress**:

a) plant development plasticity and its exploration to increase plant productivity,

b) developmental response to climate crisis,

c) plant developmental strategies that help them to avoid pathogen and pest attacks,

d) pathogens usurping plant development.

Teaching methods / techniques:

- **lectures in English,** using multimedia techniques (including ZOOM platform – depending on current situation)
- **visiting laboratories/experiments**

Evaluation of learning outcomes:

- **written exam**