UAB
Universitat Autònoma de Barcelona

2023/2024

Plant Genomics

Code: 44782
ECTS Credits: 6

Degree	Type	Year	Semester
4318297 Plant Biology, Genomics and Biotechnology	OB	0	1

Contact

Name: Narciso Campos Martinez

Email: narciso.campos@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Luisa Maria Lois Rojas

Ana Montserrat Martin Hernandez

Maria Jose Aranzana Civit

Werner Howad

Raul Castanera Andres

Pere Arús Canals

Cristina Roquet Ruiz

External teachers

Albert Ferrer Prats

Igor Flórez Sarasa

Julia Qüesta

Santiago Radío

Prerequisites

Good command of English
Good background in genetics, molecular biology and genetic engineering

Objectives and Contextualisation

Provide a global and updated view of the theoretical and technological bases related to the study of the organization, function and evolution of plant genomes and their potential applications to the genetic improvement of crop plants

Learning Outcomes

- CA05 (Competence) Recognise the ethical, social responsibility and legal considerations related to the use of genomic data, valuing respect for human and fundamental rights and the economic and environmental impact to apply them to the scientific and professional environment, in accordance with the Sustainable Development Goals.
- CA06 (Competence) Apply the knowledge acquired in new or unfamiliar environments within broader (or multidisciplinary) contexts related to Plant Biology, Genomics and Biotechnology.
- KA05 (Knowledge) Recognise the role of female scientists in the field of genetics and genomics.
- KA06 (Knowledge) Define concepts related to plant genomics and select the most appropriate methodologies for sequencing and annotating plant genomes.
- SA09 (Skill) Communicate the results of research into the organisation and function of plant genomes in English orally and in writing using appropriate scientific terminology.
- SA10 (Skill) Apply knowledge of plant genomics to the study of evolutionary mechanisms and plant and fungi systematics.
- SA11 (Skill) Apply an omics approach to the identification of new genes and processes of interest in basic and applied research.
- SA12 (Skill) Apply bioinformatic tools to genomic studies of plant systematics and phylogeny.

Content

- Plant genome organization, function and regulation.

- Transcript analysis and function.

- Molecular evolution of plants.

- Genetic markers and molecular breeding.

- Genome sequencing strategies and annotation.

- Omic aproaches

- Bioinformatics tools applied to omic studies.

Methodology

- Lectures covering the different topics of the program. Powerpoint presentations will be available at the Campus Virtual UAB.

- Reading and analysis of selected research papers by the students, for their presentation and discussion in the seminar sessions.

- Practical sessions on bioinformatics tools applied to omic studies

- Visit to the National Center for Genomic Analysis (CNAG-CRG) at the Barcelona Science Park.

Annotation: Fifteen minutes of one class, within the master program, will let students fill out evaluation questionnaires about the subject and the lecturers' performance.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Bioinformatic sessions	10	0.4	KA06, SA10, SA11, KA06
Classroom practices	4	0.16	KA06, SA12, KA06
External visit	4	0.16	CA06, KA06, CA06
Lectures	24	0.96	KA05, KA06, SA10, SA11, SA12, KA05
Seminars	4	0.16	CA05, CA06, KA05, SA09, CA05
Type: Supervised			
Preparation of oral presentations and written report for the seminars	52	2.08	CA05, CA06, SA09, CA05
Type: Autonomous			
Personal work and learning	50	2	KA06, SA10, SA11, KA06

Assessment

- Written exam

- Written report on the phylogenomics practice

- Written report on the work presented in the seminar

- Oral presentation and defense in a seminar session

- Attendance and participation in the classroom and seminar sessions

- The student will pass the subject when the sum of his/her marks reaches a minimum score of 5 out of 10

This subject does not include the single assessment system

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

Oral presentation (seminar)	25	0	0	CA05, CA06, KA05, KA06, SA09, SA10, SA11
Written exam	30	2	0.08	KA06, SA10, SA11, SA12
Written report (phylogenomics)	20	0	0	CA06, KA06, SA09, SA10, SA12
Written report (seminar)	25	0	0	CA06, KA06, SA09, SA10, SA11

Bibliography

Specific bibliography (books, book chapters and journal articles) and useful links related to Plant Genomics will be provided at the different sessions of the subject.

Software

Plant Genomics, subject presentation. Sessions program. Seminars. Evaluation. Visit to the CNAG-CRG.

Organization of plant genomes. Nuclear genome. Ploidy. Coding and non-coding regions in the genome. Repetitive DNA. Gene evolution. Pseudogenes. Genomic annotation. Plastid and mitochondrial genomes. RNA editing. Interaction between cell genomes.

Plant genome plasticity and transposable elements. Impact of transposable elements in the structure and evolution of plant genomes.

Coding and non-coding RNAs: types and biological functions. RNA polymerases. Roles of RNAs in protein synthesis and processing. RNAi silencing mechanisms: transcriptional and posttranscriptional. Small RNAs: siRNAs and hpRNAs. miRNAs: action, roles, and applications. lncRNAs.

Epigenomics. Chromatin structure and activity state. Epigenetic marks in plants. DNA methylation. Histone code.

Proteomics.

Metabolomics.

Phenotyping and phenomics.

Molecular markers. Definition. Types of molecular markers. Methods to obtain molecular markers. Genotyping methods.

Genetic linkage: mapping genes and quantitative traits (QTLs).

Linkage disequilibrium and Genome-Wide Association (GWAS).

Hands-on seminar/computer practical: Playing with genotyping data and map construction.

Plant phylogenetics and evolution. Plant molecular evolution. Introductory concepts on phylogenetics. Gene trees versus species trees: Homology, orthology, paralogy. Concerted evolution. Hybridization and introgression. Polyploidy. Lineage sorting or deep coalescence. Molecular markers used in plant phylogenetics and phylogenomics.

Bioinformatics tools in phylogenomic studies. Orthology assessment and multiple sequence alignment. Genetic distances and nucleotide substitution models. Phylogenetic inference. Parsimony analysis. Probabilistic Methods (Maximum Likelihood). Measurements of statistical support. Coalescent-based species trees.

High throughput sequencing. Introduction to Next-Generation Sequencing Platforms. Examples of applications: de novo genome sequencing, genome re-sequencing, exome sequencing, methylome sequencing.

Next-Generation Sequencing Technologies for transcriptomics. Design of RNA-seq experiments. RNA-seq (Illumina) data analysis: identification of differentially expressed genes. Practical use of the AIR platform.

Visit the "Nacional Center of Genomic Analysis" (CNAG-CRG). Overview of the CNAG. Next Generation Sequencing Technologies. Bioinformatics Essentials for Next Generation Sequencing. De novo assembly and annotation in plant genomes

Seminars. Oral presentation of published research by students.