Master 1 Sciences du végétal

Master Biologie intégrative et physiologie

Université Paris Cité

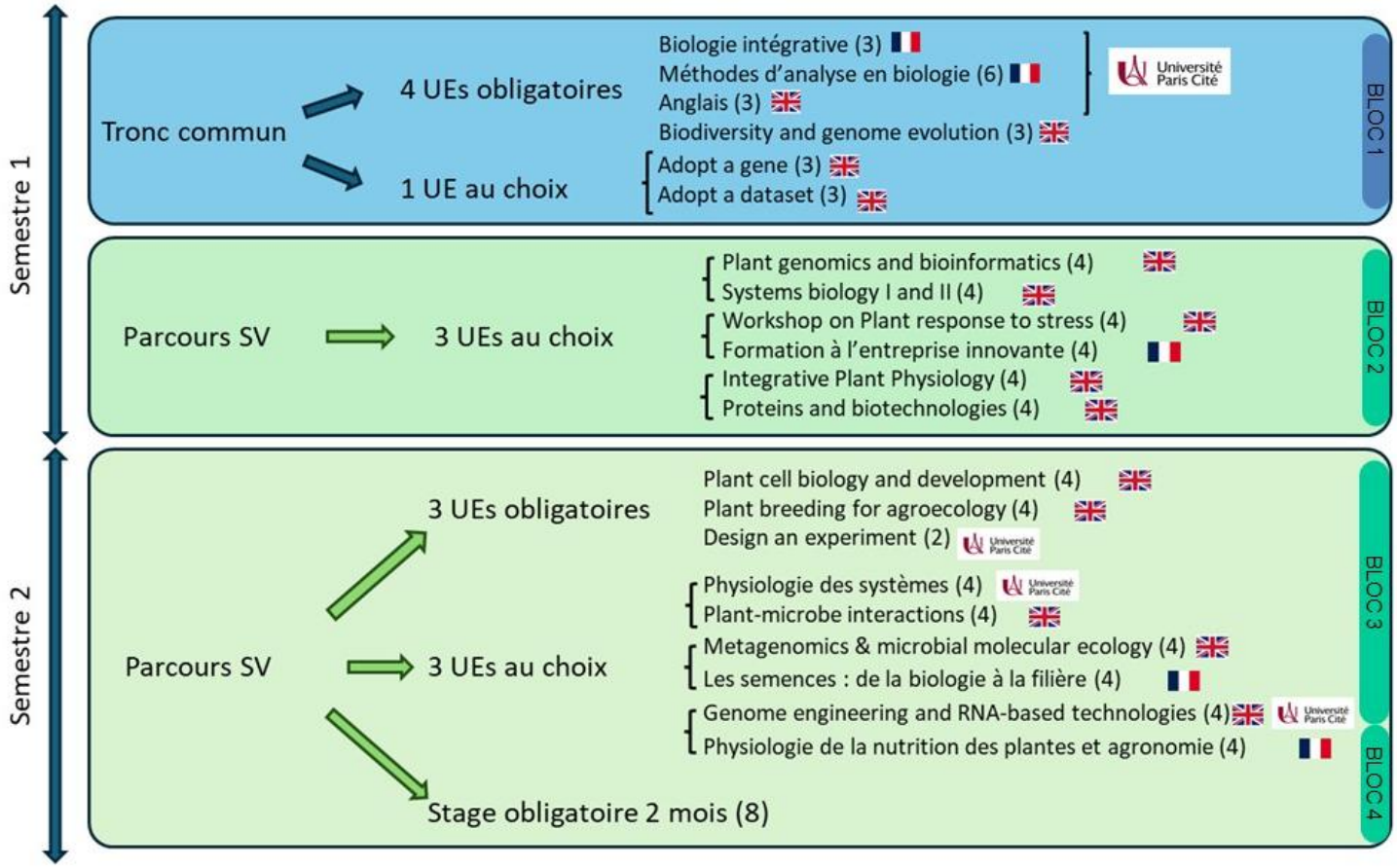
Fiches UE

Année 2026-2027

https://master-bip-universite-paris.fr

Ces fiches sont informatives. Des changements dans les contenus pédagogiques des enseignements peuvent être décidés par les enseignants.

Structure du M1



BCC1 : Integrative foundations and methods for animal and plant sciences

Intitulé UE/ECUE	**Biologie intégrative (Paris Cité)** 	
Type d'UE/ECUE	Obligatoire, Tronc Commun PAPH & SV	
Responsable de l'UE/ECUE	S. Filleur / C. Dugast	
Semestre	M1S1	
Nombre d'ECTS	3	
Lieu , organisation	Paris Cité, Grands Moulins, tronc commun (lundi AM)	
Volume horaire présentiel étudiant	Nombre d'heures de CM : 15h Nombre d'heures de TD : 10h	
Objectifs en terme de connaissances	Décrire, expliquer et discuter la relation génotype/fonction, mécanismes généraux et intégration de réponses aux stress chez les organismes eucaryotes pluricellulaires	
Compétences visées	Communiquer des données scientifiques sous forme d'un poster	
Contenu de l'UE/ECUE	Aspects cellulaires et moléculaires de « problèmes biologiques complexes », illustrés par des exemples issus des règnes animal et végétal : réponses au stress thermique, au stress génotoxique et au stress nutritionnel.	
Modalités de contrôle des connaissances	Session 1	CC TD 30% (poster)/ EXT 70%
	Session 2	CC TD 30% (présentation poster) / EXT 70% avec conservation note CC si > ou = à 10

BCC1 : Integrative foundations and methods for animal and plant sciences

Intitulé UE/ECUE	**Méthodes d'analyse statistique en biologie 1, ECUE** **Biostatistiques (Paris Cité)**	
Type d'UE/ECUE	Obligatoire, TC PAPH & SV	
Responsable de l'UE/ECUE	I. Kousignian	
Semestre	M1S1	
Nombre d'ECTS	3	
Lieu de l'enseignement	Paris Cité, campus Grands Moulins et St Germain , tronc commun (lundi et vendredi)	
Volume horaire présentiel étudiant	Nombre d'heures de CM : 10 Nombre d'heures de TD : Nombre d'heures de TP : 12	
Objectifs en terme de connaissances	Choisir et maîtriser les principaux outils statistiques de base adaptés à l'analyse de données biologiques	
Compétences visées	Etre capable de mener et réaliser une étude statistique en autonomie et en groupe à l'aide du logiciel statistique R.	
Contenu de l'UE/ECUE	L'enseignement est composé de cours magistraux et de travaux pratiques. Les séances de cours magistraux se feront en amont afin de poser les cadres théoriques aux différentes méthodes d'analyses statistiques de données et ce à travers : l'assimilation du vocabulaire utilisé et le choix de procédures statistiques selon la problématique d'étude. La mise en pratique de ces cours se fera sous forme de travaux pratiques en salle informatique à l'aide d'un logiciel statistique de traitement des données. L'objectif sera d'étudier des problématiques concrètes, à travers l'analyse de bases de données, afin de mettre en place les notions et procédures statistiques vues en cours. Le logiciel utilisé, logiciel R, est libre et compatible multi-plateformes afin que les étudiants puissent l'installer pour pratiquer sur leur ordinateur personnel.	
Modalités de contrôle des connaissances	Session 1	Examen terminal (écrit) : 100%
	Session 2	Examen terminal (écrit): 100%

BCC1 : Integrative foundations and methods for animal and plant sciences

Intitulé UE/ECUE	**Méthodes d'analyse en biologie 1, ECUE Outils informatiques pour Biologistes (Paris Cité)** 	
Type d'UE/ECUE	UE à choix, TC PAPH & SV	
Responsable de l'UE/ECUE	D. FLATTERS / L. TAMISIER	
Semestre	M1S1	
Nombre d'ECTS	3	
Lieu de l'enseignement	Paris Cité campus St Pères, tronc commun (vendredi)	
Volume horaire présentiel étudiant	Nombre d'heures de CM : 8h Nombre d'heures de TD : Nombre d'heures de TP : 17h	
Objectifs en terme de connaissances	Choisir et maîtriser les outils adaptés à l'analyse des données expérimentales complexes (bio-analyses)	
Compétences visées	organiser un travail en autonomie et en groupe	
Contenu de l'UE/ECUE	• *Shell* • *Analyse et comparaison de séquences biologiques* • *Graphisme moléculaire* • *Modélisation par homologie* • *Réseaux d'interaction* • *Initiation à la programmation R pour l'analyse de données (3 séances)* • *Voies métaboliques*	
Modalités de contrôle des connaissances	Session 1	CC TP 100%
	Session 2	CC TP 50% (report note session 1) + EXT 50%

BCC1 : Integrative foundations and methods for animal and plant sciences

Intitulé UE/ECUE	**Méthodes d'analyse en biologie 1, ECUE Initiation à la programmation Python (Paris Cité)** 	
Type d'UE/ECUE	UE à choix, TC PAPH & SV	
Responsable de l'UE/ECUE	I. NICOLIS	
Semestre	M1S1	
Nombre d'ECTS	3	
Lieu de l'enseignement	Paris Cité campus St Pères, tronc commun (vendredi)	
Volume horaire présentiel étudiant	Nombre d'heures de CM : 9h Nombre d'heures de TD : Nombre d'heures de TP : 16h	
Objectifs en terme de connaissances	Introduction à l'algorithmique, notamment boucles et conditions.	
Compétences visées	Mettre en œuvre les usages avancés et spécialisés des outils numériques	
Contenu de l'UE/ECUE	*L'enseignement a lieu en salle informatique sous la forme de cours et de séances interactives dirigées qui mettent en pratique les notions abordées en cours. Un mini-projet par petits-groupes est à développer. Les logiciels utilisés sont libres et compatibles multi-plateformes afin que les étudiants puissent les installer pour pratiquer sur leurs ordinateurs personnels.* *Types de variables en python, y compris listes et dictionnaires. Définition et utilisation de fonctions et d'objets. Utilisation de modules supplémentaires, notamment en bioinformatique et interfaçage graphique.*	
Modalités de contrôle des connaissances	Session 1	CET 100%
	Session 2	ET 100% (1h écrit)

BCC1 : Integrative foundations and methods for animal and plant sciences

Intitulé UE/ECUE	**Anglais (Paris Cité)** 	
Type d'UE/ECUE	Obligatoire, TC PAPH & SV	
Responsable de l'UE/ECUE	P. CHOLET	
Semestre	M1S1	
Nombre d'ECTS	3	
Lieu de l'enseignement	Paris Descartes, tronc commun (mercredi matin)	
Volume horaire présentiel étudiant	Nombre d'heures de CM : Nombre d'heures de TD : 18 Nombre d'heures de TP : Nombre d'heures autres formes d'enseignement : 8h	
Objectifs en terme de connaissances	Rédiger et présenter des concepts scientifiques à un public non spécialiste.	
Compétences visées	Acquisition du niveau CECR B2	
Contenu de l'UE/ECUE	Développement des quatre compétences qui sont l'expression orale, l'expression écrite, la compréhension orale et écrite, compétences ancrées principalement dans le contexte scientifique, dans l'étude de documents authentiques. Pendant le semestre, les étudiants devront travailler leur rigueur grammaticale et lexicale, notamment afin de pouvoir s'exprimer de façon claire et précise, afin de comprendre les nuances auxquelles ils seront exposés. En plus que de l'aspect linguistique, ils seront invités à présenter des exposés, à rédiger des essais qui solliciteront un travail sur la méthodologie de l'argumentation qui peut-être une difficulté majeure en langue étrangère.	
Modalités de contrôle des connaissances	Session 1	100% CC (E et O)
	Session 2	100% ET (E ou O)

BCC1 : Integrative foundations and methods for animal and plant sciences

Biodiversity and Genome Evolution (Paris-Saclay)

Keywords
Genomic diversity, homology, recombination, transposable elements, duplication, polyploidy, euchromatin vs. heterochromatin, coding vs. non-coding genome, structural variants, alternative splicing, high-throughput sequencing (NGS)

Description of the course content

Objectives:
This module aims to present the notion of biodiversity as a whole, with particular emphasis on its genetic and genomic aspects, giving a prominent place to the fundamentals of population genetics and to understanding the dynamics of genetic evolution within a population.

It also focuses on the main mechanisms involved in the structural evolution of genomes and in the dynamics of the regulation of their expression, incorporating the epigenetic mechanisms underlying functional diversity.

Content:
Population genetics (15 h): key concepts of population genetics; influence of reproductive systems on genetic diversity; effects of selection and drift on population evolution; the balance between mutation and selection, and cryptic polymorphism; the origin of species diversity and the processes of speciation.

Structure and evolution of the eukaryotic genome (4 h 30): major genome components, transposable elements and structural and functional diversity, genome duplication and innovation in species adaptation.

Epigenetics (5 h): chromatin organization (euchromatin, heterochromatin); gene expression (histone modification, DNA methylation); alternative splicing.

Number of ECTS credits
3 ECTS

Skills to be acquired
- Be able to solve a population genetics problem
- Explain the epigenetic basis of the regulation of gene expression
- Describe the processes generating diversity in eukaryotic genomes
- Give a concise account of a scientific study and identify the main results and conclusions to be retained, using a mind map

Organization and monitoring arrangements
Lectures to define new concepts.

Knowledge-application exercises during the lectures; discussion-based tutorials, linked to the lectures, on the concepts covered.

Literature workshop with in-class presentation and discussion, illustrating with examples the notions and concepts covered in the lectures.

Supervised project (2 h 30) based on the analysis of a scientific paper, drawing on the knowledge acquired during the module and using *mind mapping* to structure thinking and argument for an assessed oral presentation.

Description of the teaching team

Coordinators:

Karine Alix Professor, AgroParisTech (karine.alix@agroparistech.fr)
Pierre Gérard Associate Professor, AgroParisTech (pierre.gerard@agroparistech.fr)

Teaching team:

Moussa Benhamed, Professor, Université Paris Cité; David Latrasse, Associate Professor, Université Paris-Saclay

Main teaching language

English

Total teaching hours

Lecture hours: 15 h
Total tutorial hours: 9.5 h
Total supervised project hours: 2.5 h

Teaching period and course location

Period:

Semester 1 – September to November

Location:

AgroParisTech, Palaiseau campus; Université Paris Cité - Paris Rive Gauche campus (13th arrondissement)

Assessment method

Session 1:

Continuous assessment 30% (oral mind-map project), written exam: 70%

Session 2:

Continuous assessment 30% (mark carried over from session 1), written exam 70%

BCC1 : Integrative foundations and methods for animal and plant sciences

Project 'Adopt a gene' (Paris Cité)

Optional course unit A, option 1

Keywords

Gene, accession, genomics, RNA, protein, bioinformatics, project, literature review

Intended learning outcomes

Illustrate the main methods for studying a gene or a protein (experimental methods and in silico tools). Define a relevant biological question from existing data on a scientific topic. Propose an experimental design. Be able to construct a query using AI tools to produce a summary, and to identify and correct any errors in it. Be able to produce a scientific figure with a caption and explanation, and to present it orally.

Number of ECTS credits

3 ECTS

Skills to be acquired

Produce a synthesis of scientific data
Find reliable sources and present scientific results
Communicate orally
Master basic biology laboratory techniques and know the safety rules

Organization and monitoring arrangements

Supervised project - each student is tasked with studying a gene or a protein proposed by a researcher. They carry out a review of the state of the art, perform additional (in silico) analyses, and then identify a relevant biological question.

Course organization:
Study of an accession (searching bibliographic and biological databases, bioinformatics analyses) - 6 computer-based practical sessions of 2 h
Basic molecular biology techniques - 1 practical session of 3 h

Prerequisites

General Bachelor's-level life sciences teaching in molecular biology, genetics and genomics; basics of bioinformatics (sequence analysis)

Description of the teaching team

Coordinators:
Jean-Denis Faure, Professor, AgroParisTech (jean-denis.faure@agroparistech.fr)
Christine Lelandais-Brière, Associate Professor, Université Paris Cité (christine.lelandais@u-pariscite.fr)

Main teaching language

English

Total contact hours
Total practical hours: 15 h

Teaching period and course location
Period: Semester 1 - core curriculum (mid-September to mid-November)
Location: Université Paris Cité, Halle aux Farines - Paris Rive Gauche campus (13th arrondissement)

Assessment method
Session 1:
Oral presentation (in English): 60%, written report on the gene analysis and project: 40% (in English)
Session 2:
Session 1 written report 20% + written exam 80%

BCC1 : Integrative foundations and methods for animal and plant sciences

Project 'Adopt a dataset' (Paris-Saclay)

Optional course unit A, option 2

Keywords
dataset, statistics, database, bibliography

Course content and teaching objectives
During this course, students will be given a data set to analyse in depth. The teaching is based on active pedagogy, accompanied by a scientific tutor who will have his or her own dataset to be analysed.

Number of ECTS credits
3 ECTS

Objectives
During this course, students will learn to:

- Exhaustively search and synthesise the information available in public databases (bibliographic, genomic, transcriptomic, proteomic data, etc.)
- The use of certain software to analyse these data
- Identify a relevant biological question from their synthesis
- Design and present a mini research project to answer this biological question and to deepen the knowledge about it.

Prerequisites
Basics of statistics and bioinformatics

Description of the teaching team
Elodie Marchadier, Associate Professor, Université Paris-Saclay (elodie.marchadier@universite-paris-saclay.fr)
Marta Vazquez Gomez , Associate Professor, AgroParisTech (marta.vazquezgomez@agroparistech.fr)
Christelle Loncke, Associate Professor, AgroParisTech (christelle.loncke@agroparistech.fr)

Main teaching language
English

Total contact hours
Lecture hours: 3 h
Total practical hours: 12 h

Teaching period and course location
Period: Semester 1 - core curriculum (mid-September to mid-November);
Location: AgroParisTech, Palaiseau campus; Université Paris Cité - Paris Rive Gauche campus (13th arrondissement)

Assessment method
Session 1: written exam 100% (report)
Session 2: 70% written report and 30% continuous assessment

BCC2 : Plant sciences: from specialised knowledge to innovative methods for sustainability

Plant Genomics and Bioinformatics (Paris-Saclay)

Optional course unit B, option 1

Keywords

Applications of genomics to crop plants; databases; bioinformatics; evolution; genomics; polymorphism; bioanalytical project; gene regulatory networks and interaction networks; high-throughput sequencing; genome structure

Description of the teaching content

Objectives:

Understand the basic elements and specificities of genomics as applied to cultivated plants. Use the different bioinformatics databases and their characteristics to perform an appropriate search by selecting specific parameters. Understand the specificities of genome evolution in cultivated plants, as well as the natural and artificial processes involved in creating genetic diversity.

Explain the principles of long-read sequencing and evaluate its advantages for *de novo* assembly up to T2T genomes. Describe the concepts of pangenomes and pangenomics.

Content:

The application of genomics and bioinformatics tools to the study of the genome of cultivated plants will be presented. The specific features of genome structure, such as duplications, transposable elements and multi-genomes, as well as the genome diversity of cultivated plants, including heterozygosity, will be discussed in relation to the evolution of crops and specific agronomic traits. The specificities of organelle genomes will also be presented and discussed. The available genetic and genomic resources will be presented in light of their potential applications. The section on teaching bioinformatics through practical exercises will expand on the concepts of comparative genomics, protein motif research, and structure-function relationships. It will also introduce gene regulatory networks and protein-protein interaction networks, demonstrating how to construct and analyse them for functional annotation.

This course provides an overview of the principles of long-read sequencing and its advantages for generating high-quality de novo assemblies, including those of entire genomes from telomere to telomere (T2T). Students will explore methods for evaluating the quality of genome assemblies and discuss their key applications in genomics research. The course will introduce pangenomes and pangenomics, emphasising their role in representing genetic diversity beyond single reference genomes.

Number of European credits

4 ECTS

Skills to be acquired

- Explain the importance of high-throughput sequencing and bioinformatics in plant genome analysis, outlining the advantages and limitations of next-generation sequencing techniques.
- Describe the main mechanisms of plant genome evolution, such as polyploidy, interspecific hybridization, transposition and structural rearrangements.
- Explain the molecular mechanisms involved in creating useful diversity for improving crops.

- Know how to use public databases and bioinformatics tool platforms.
- Present a scientific study and summarise the main results and conclusions; know how to communicate a scientific message.

Organisational and monitoring arrangements

Lectures to introduce and define new concepts.
The course involves mainly practical work using bioanalysis tools to introduce bioinformatics, as well as supervised work for the assessed bioinformatics project.
Supervised bibliographic work to analyse articles for an assessed oral presentation.

Teaching team

Coordinators:

Bénédicte Sturbois Professor, Université d'Evry Val d'Essonne (benedicte.sturbois@univ-evry.fr)
Karine Alix Professor, AgroParisTech (karine.alix@agroparistech.fr)

Other members:

Gianluca Teano, Associate Professor, Université d'Evry Val d'Essonne
Nathalie Boudet, Associate Professor, Université d'Evry Val d'Essonne

Main teaching language

English

Overall time table

Lectures: 17h
Tutorials and practical course: 14.5h
Supervised project: 4.5h
Total number of teaching hours : **36h**

Period of instruction and location of courses

Period: Semester 1 – November
Location: IPS2 building 630, Université Paris-Saclay, avenue des Sciences, Plateau du Moulon; AgroParisTech, Palaiseau campus

Control of knowledge

Session 1:

Oral presentation using a poster to present the analysis of a scientific article 75% + report on the supervised bioinformatic project carried out on genomic data during the course 25%
Attendance and participation in lessons, as well as completion of a related questionaire, will also be taken into account

Session 2:

100% written exam (EE) if > 4 students and 100% oral examination if ≤ 4 students

BCC2 : Plant sciences: from specialised knowledge to innovative methods for sustainability

Systems Biology I & II (Paris-Saclay)

Optional course unit B, option 2

Key words

Modelling; -omics data; systems biology

Description of the teaching content

Objectives:

System Biology I. Students will see different methods to produce transcriptome, ORFeome, proteome and interactome resources and how to integrate them in modeling approaches to have new insights on cellular processes. **System Biology II.** In this course, students will explore a number of mathematical approaches to tackle biological issues through the integration of "omics" data. The mathematical approaches include the methods known as constraint-based modeling, i.e. flux balance analysis, resource balance analysis, but also tools specific to the analysis of dynamic systems and Boolean systems.

Content:

System Biology I. Integrative approaches are key steps in the thorough exploitation of omics data and their translation into knowledge. In this module, students will have courses on the architecture and the machinery of the cell, and on the genome and epigenome organization. They will learn how to combine predictive and experimental approaches to decode the genomic information through the structural and functional annotation of genomes. The integration and the querying of heterogeneous data imply to perfectly know their origin in order to take into consideration their quality, relevance and confidence levels. The understanding of this approach is the basis of holistic analyses for systems biology. **System Biology II.** Global analyses (omics) currently generate large datasets that do not capture the complexity of living systems. Systems Biology is an approach where omics data are integrated and exploited (compared) through mathematical models of biological systems or sub-systems. The complexity of biological systems and the diversity of issues to be considered require the use of different types of modelling.

Number of European credits

4 ECTS

Skills to be acquired

On completion of the course, students will be able to:

- Have a good understanding of the challenges posed by integration of omics data. They should be able to understand and summarize a scientific paper in the field.
- Understand and explain the challenges of using constraint-based modeling approaches to describe cellular behaviours
- Summarize and present a scientific paper in the field.

Organisational and monitoring arrangements

Lectures and practical tutorials will be intermixed during this course.

Teaching team

Coordinators:

Matthieu Jules Professor, AgroParisTech (matthieu.jules@agroparistech.fr)
Guillem Rigaill Research Director, INRAE (guillem.rigaill@inrae.fr)
Anne Goelzer Research Engineer, INRAE (anne.goelzer@inrae.fr)

Teaching language

English

Overall timetable

Volume of lectures: 18
Total number of hours of practical work: 18
Total number of hours: **36**
+ project to be carried out autonomously

Period of instruction and location of courses

Period: Semester 1- November
Location: UEVE, Evry

Control of knowledge

Session 1:

Oral presentation (EO) 50%; Written exam (EE) 45%; Attendance and participation in classes 5%

Session 2:

100% written exam (EE)

BCC2 : Plant sciences: from specialised knowledge to innovative methods for sustainability

Workshop on plant responses to biotic and abiotic stresses

(Paris-Saclay)

Optional course unit C, option 1

Keywords

plant beneficial microbe, biotic and abiotic stresses

Description of the teaching content

Objectives:

To provide students with a technical base and scientific reasoning enabling them to approach future laboratory or company internships with more confidence, thanks to the conduct of a mini research project involving various experimental approaches (plant pathology, molecular physiology, cytology, analysis of transgenic plants, analysis of transcriptomic data). These approaches are based on the plant *Arabidopsis thaliana*, under development or faced with biotic (plant pathogenic microorganisms) or abiotic (salt) stresses.

Content:

This course consists mainly in a practical approach as well as intensive scientific reasoning based on a theme close to a research question. In recent years, the theme chosen has been the following: What is the impact of a beneficial bacterium of the plant responses to biotic and abiotic stresses? Other research questions may potentially replace the current theme, but the idea is to maintain a set of integrative questions in the field of plant response to biotic and/or abiotic stresses. In parallel, the students are implementing a complete approach to a Koch postulate (diagnosis of the pathogen responsible for symptoms observed on plants).

Techniques and methodologies used: DNA extraction, PCR and quantitative PCR, different methods of inoculation of pathogens on plants and qualitative and quantitative analysis of symptoms, Koch's postulate, manipulation of different bioinformatics tools (blastn, AgriGO, G.Profiler, MEME, STRING, KEGG,...).

Interactive tutorials, generally in the form of round tables, will allow students to step back from the experimental work carried out and to broaden the scope of their experimental strategies in response to a biological question. They allow the students to refresh the basic principles of numerous techniques by integrating them into a research approach (analysis of mutants, transformation techniques for higher plants and limitations, regulation of gene expression, signalling, microscopy techniques, use of gene expression databases).

Number of European credits

4 ECTS

Skills to be acquired

- Exploit online public databases as well as bioinformatics tool platforms (reinforcement)
- Design and implement a scientific approach to answer a biological question(s)
- Know the main approaches and techniques used for the functional characterisation of a gene in a model plant species
- Implement the basic approaches in phytopathology.

Complementary skills:
- Present a scientific study: explain the approach and summarize the main results and conclusions to be retained; know how to communicate a scientific message.

Teaching team

Coordinators:
Marie Dufresne Professor, Université Paris-Saclay (marie.dufresne@universite-paris-saclay.fr)
Axel de Zélicourt Associate Professor, Université Paris-Saclay (axel.de-julien-de-zelicourt@universite-paris-saclay.fr)
Other members:
Benoît Alunni, Research Director INRAE, IJPB INRAE Versailles
Martine Thomas, Associate Professor, Université Paris-Saclay

Teaching language

English

Overall timetable

Volume of lectures: 0
Total number of hours of practical work: 36
Total number of hours of tutorials: 6
Total number of hours: **42**

Period of instruction and location of courses

Period: Semester 1- November & December
Location: IPS2 building 630, Université Paris-Saclay, avenue des Sciences, Plateau du Moulon

Control of knowledge

First session:
Continuous assessment (oral examination at the end of the course): 70% + written file consisting of a formatted analysis of the collected transcriptomics data: 30%
Second session:
100% oral examination

BCC2 : Plant sciences: from specialised knowledge to innovative methods for sustainability

Fonctionnement de l'Entreprise Innovante (FEI) (Paris-Saclay)

UE à choix C, option 2

Mots Clés

Entrepreneuriat, Innovation, Marketing

Description du contenu de l'enseignement

L'UE a été créée afin de permettre à tout étudiant en Sciences d'appréhender le monde économique et le monde de l'entreprise : après une série de conférences d'Economie générale, le monde de l'entreprise est présenté à travers les grandes fonctions de l'entreprise, de la multinationale à la start-up. Ces enseignements s'appuient sur des enseignants ayant une expérience de création d'entreprise et des professionnels.

- *Objectifs :*

- Maîtriser les concept clés de l'analyse économique (croissance économique, concurrence, libéralisme, intervention publique)
- Comprendre le lien entre innovation, croissance et profit.
- Appréhender la recherche, l'information et la connaissance comme des éléments essentiels de la compétitivité de l'entreprise.

- *Contenu :*

- Economie de marché et libéralisme
- Circuit économique et intervention publique
- Economie de l'innovation et croissance économique
- Recherche, Innovation et Concurrence interfirmes

Nombre de crédits européens

4 ECTS

Compétences à acquérir

- Etre capable d'appréhender et de décrire l'environnement économique de l'entreprise
- Comprendre les contraintes et le fonctionnement de l'entreprise pour mieux s'y insérer
- Maîtriser les enjeux de l'innovation dans la compétitivité de l'entreprise

Modalités d'organisation et de suivi

Cours magistraux, lecture et analyse d'articles scientifiques et de la presse économique, documentaires audiovisuels, travail en petits groupes

Description de l'équipe pédagogique

Coordinateur :

Fabrice Lequeux, MCF Université Paris-Saclay (fabrice.lequeux@universite-paris-saclay.fr)

Langue principale d'enseignement

Français

Il est possible de traduire les diapos de cours en anglais. Les étudiants non francophones peuvent rédiger leur copie d'examen (1ère session) et passer l'examen oral (2ème session) en anglais.

Volume horaire global

Volume horaire de cours : 36h
Volume horaire de TP et TD : 0
Volume horaire global du cours : **36h**

Période d'enseignement et localisation des cours

Période : Semestre 1 – Novembre et Décembre.
Lieu : Université Paris-Saclay, Orsay

Modalités de contrôle des connaissances

Session 1 : F = examen écrit EE 100%
Session 2 : F = examen oral EO 100%

BCC2 : Plant sciences: from specialised knowledge to innovative methods for sustainability

Integrative Plant Physiology (Paris-Saclay)

Optional course unit D, option 1

Key words

Photosynthesis; regulation; environmental constraints; light management; oxidative stress; chemical stress; secondary metabolism

Description of the teaching content

Prerequisites (strongly recommended):
Good knowledge of the basics of plant physiology and metabolism.

Objectives:
Students will acquire theoretical and practical knowledge aimed at furthering their understanding of the flexibility of plant function in a changing and potentially stressful environment. Group-centered bibliographic research projects are focused on key players in metabolic responses to external factors, and involve the preparation of a report in the form of a structured and logical oral presentation. Supervised exercises aim at the acquisition of a more in-depth knowledge of plant biochemistry and molecular biology.

Content:
The module involves interactive discussions, exercises (including some that involve the preparation of written reports), and work undertaken by students in small groups towards the preparation of oral presentations on a given topic.

Number of European credits

4 ECTS

Skills to be acquired

- Understand key aspects of plants' response to the environment
- Be able to integrate information presented under the various topics covered in the lectures
- Develop skills and critical analysis of laboratory practices in the context of a functional genomics study
- Develop teamwork skills to prepare presentations
- Be able to carry out a literature review and structure the information so as to present it in the form of a critical and clearly illustrated oral presentation

Organisational and monitoring arrangements

Tutorials, exercises, supervised projects

Teaching team

Coordinators:
Graham Noctor, Professor, Université Paris-Saclay (graham.noctor@universite-paris-saclay.fr)
Hélène Vanacker, Professor, Université Paris-Saclay (helene.vanacker@universite-paris-saclay.fr)

Other members:
Willian Bouard, Associate Professor, Université Paris-Saclay

Teaching language

English

Overall timetable

Volume of lectures: 20h
Volume of tutorials: 16h
Total number of teaching hours: **36h**

Period of instruction and location of courses

Period: Semester 1 – Last week of December (before Christmas Holidays) – First week of January (after holidays)
Location: IPS2, teaching building 630, Université Paris-Saclay, Gif-sur-Yvette

Control of knowledge

Session 1:
Continuous assessment (CC) 100%
Session 2:
Oral examination (EO) 100%

BCC2 : Plant sciences: from specialised knowledge to innovative methods for sustainability

Proteins & Biotechnologies (Paris-Saclay)

Optional course unit D, option 2

Keywords

Plant proteins, insect proteins, microorganisms, biotechnology, genetic engineering, protein engineering, mutagenesis, transgenesis, cisgenesis, *genome editing*, synthetic biology, systems biology, ethics, regulation, agriculture, food

Description of the teaching content

The program first introduces the major families of alternative proteins (plant-based, insect-derived, microbial), their functional properties, and their prospects for use in food systems. It then addresses the biotechnological approaches involved, ranging from conventional techniques such as mutagenesis, transgenesis and cisgenesis, to new genome editing technologies, as well as the contributions of protein engineering, synthetic biology, and systems biology.

Cross-cutting themes, including protein separation, industrial transformation processes, and metabolic pathway engineering, are also explored.

Ethical, societal, and regulatory aspects of applying biotechnology to food production are considered throughout.

The course is complemented by a research and development centre visit, allowing students to directly link theoretical knowledge with industrial applications.

Number of European credits

4 ECTS

Skills to be acquired

Assessment in this unit is designed to evaluate a combination of scientific knowledge, analytical ability, and applied problem-solving skills. The written report assesses students' capacity to synthesise scientific literature, critically appraise biotechnological approaches, and contextualise them within ethical and regulatory frameworks. The oral examination evaluates students' ability to communicate complex scientific concepts clearly, defend arguments, and demonstrate integrative understanding across molecular, physiological, and technological dimensions. The written examination in the second session tests comprehensive knowledge of alternative protein sources, mastery of genetic and protein engineering techniques, and the ability to apply theoretical concepts to novel or emerging biotechnological challenges.

Organisational and monitoring arrangements

The unit is structured around 14h of lectures, 16h of tutorials, and 6h dedicated to a supervised project, in addition to the R&D centre visit.

Lectures provide the conceptual foundations and highlight recent advances in the field, while tutorials encourage active learning through case studies, critical discussions, and problem-solving exercises. The supervised project allows students to work independently on an applied problem, thereby integrating theoretical knowledge with creativity and analytical skills.

Assessment in the first session consists of coursework (written dossier, 30%) and an oral examination (70%), while the second session consists of a final written examination (100%). This structure supports progressive, interactive learning and fosters analytical, critical, and applied competences required to address the challenges of protein biotechnology.

Teaching team

Coordinators:
Loïc Rajjou, Professor, AgroParisTech (loic.rajjou@agroparistech.fr)
Julia Zinsmeister, Associate Professor, AgroParisTech (julia.zinsmeister@agroparistech.fr)

Main teaching language

English

Overall timetable

Volume of lectures: 14h
Volume of tutorials: 16h
Supervised project: 6h
Total number of teaching hours: **36h**

Period of instruction and location of courses

Period: Semester 1 – Last week of December (before Christmas Holidays) – First week of January (after holidays)
Location: AgroParisTech, Palaiseau campus

Control of knowledge

Session 1:
Continuous assessment CC 100%
Written report 30% + oral examination in relationship with the report 70%

Session 2:
Written examination EE 100%

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Plant cell biology and development

(Paris-Saclay)

Keywords

Plant development, Evo-Devo, cellular and genetic analysis, model and cultivated plant species

Description of the content of the teaching

Objectives:

The aim of this course is to understand and master key concepts in plant developmental biology at the molecular, cellular and whole-organism levels. The topics covered, whether in model or cultivated plant species, will concern the major stages of plant life and morphogenesis, responses to environmental changes, natural diversity and variation, and some aspects of Evo-Devo. This knowledge can be re-used to explore new themes in future courses, whether or not they focus on the study of development.

Content:

The course unit will include a component of traditional teaching (lectures, tutorials and practical sessions), sessions focused on debate and the formulation of questions, as well as a series of presentations during which students will be invited to present and discuss analytical techniques and lab methods.

The teaching unit is divided into 3 learning and thematic blocks:

- What is a plant cell and what is plant development?
- How to study plant development?
- How developmental knowledge can be useful?

Number of European credits

4 ECTS

Skills to be acquired

The assessment will focus on the ability to integrate theoretical information, data analysis and bibliographic references presented in the form of presentations and written reports.

Teaching team

Coordinator:

Marianne Delarue Professor, Université Paris-Saclay (marianne.delarue@universite-paris-saclay.fr)

Other members:

Moussa Benhamed, Professor, Université Paris Cité; Yves Deveaux, Associate Professor, Université Paris-Saclay; David Latrasse, Associate Professor, Université Paris-Saclay; Cécile Raynaud, Research Director CNRS; Dao-Xiu Zhou, Professor, Université Paris-Saclay

Main teaching language

English

Overall timetable

Lectures: 20h
Tutorials: 10h
Practical sessions: 6h

Teaching period and location of courses

Period: Semester 2 – February
Location: IPS2 building 630, Université Paris-Saclay, avenue des Sciences, Plateau du Moulon

Knowledge test mode

Session 1:
Continuous assessment CC 50% + Oral examination EO 50%
Session 2:
First term CC mark is retained 50% + Oral examination EO 50%

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Plant breeding for agroecology

(Paris-Saclay)

Keywords

Genetic mapping; QTL detection; plant breeding; quantitative genetics; population genetics

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Description of the course content

Objectives

- Consolidate the genetic foundations underlying the processes of evolution and of population structuring in a plant breeding context
- Know the genetic basis of quantitative traits
- Implement a QTL detection approach

Content

- Population genetics (linkage disequilibrium, genetic drift and population evolution)
- Crossing designs and genetic mapping
- Mechanisms of genome evolution
- Introduction to quantitative genetics and methods for studying complex traits, including resistance and adaptation traits
- The genetic basis of the domestication of cultivated plants
- Genetic resources and their value in plant breeding

Number of ECTS credits

4 ECTS

Skills to be acquired

- Know the principles governing the evolution of the genetic structure of a population
- Be able to explain what a quantitative trait is
- Know the methods used to characterize the genetic basis of a quantitative trait
- Be able to explain what genetic resources are, the forms in which they exist and how to use them in plant breeding
- Be able to explain the importance of genetic diversity in a plant breeding program
- Implement a QTL detection approach
- Carry out a DNA extraction and genotyping using SSR markers

Organization and monitoring arrangements

Lectures introducing concepts and definitions. Practicals and tutorials on genotyping, genetic mapping and QTL detection. A visit is organized to the GQE-Le Moulon laboratory at IDEEV, including the molecular biology and proteomics platforms as well as the greenhouses.

Description of the teaching team

Coordinator:

Sarah Ben Sadoun Associate Professor, AgroParisTech (sarah.ben-sadoun@agroparistech.fr)

Teaching team:

Karine Alix, Professor AgroParisTech; Julie Fiévet, Associate Professor AgroParisTech; Marianne Laurençon, Associate Professor AgroParisTech

Main teaching language
English / French

Total teaching hours
Lecture hours: 18 h
Practical hours: 12 h
Tutorial hours: 6 h

Compulsory prerequisites
Foundations in classical genetics and molecular biology

Teaching period and course location
Period: Semester 2 - April
Location: IDEEV and the GQE-Le Moulon laboratory, 12 route 128, 91190 Gif-sur-Yvette

Assessment method
Session 1:
Continuous assessment CC with the practical report 25% + final written exam EE 75%
Session 2:
Continuous assessment CC practicals 25 % (mark carried over from session 1) + 75% written exam, or oral exam if ≤4 students

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Design an experiment (Paris Cité)

Keywords
Introduction to research, formulating a research hypothesis, experimental design, putting theory into practice

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Description of the content of the teaching

Objectives:

- Training to conduct experiments
- Designing and carrying out a biological experiment independently

Content:
Lectures: experimental methods, characteristics of a scientific experiment
Tutorials: designing an experiment to validate results obtained using a -'omics' approach
Practical course: carrying out the experiment (in a specific laboratory, during a practical session)

Number of European credits
2,5 ECTS

Skills to be acquired
- work as part of a team
- design and carry out a relevant experiment to answer a specific biological question
- critically analyse a methodology and data

Teaching team
Coordinators
Christine Lelandais Associate Professor, Université Paris Cité (christine.lelandais@u-pariscite.fr)
Sophie Piquerez Associate Professor, Université Paris Cité (sophie.piquerez@universite-paris-saclay.fr)

Main language of teaching
English

Overall timetable
Lectures: 4h
Tutorials: 15h
Practical course: 6h
Total number of teaching hours: **36h**

Teaching period and location of courses
Period: Semester 2 – 3rd week of February
Location: Université Paris Cité – Grands Moulins campus

Knowledge test mode

Session 1:

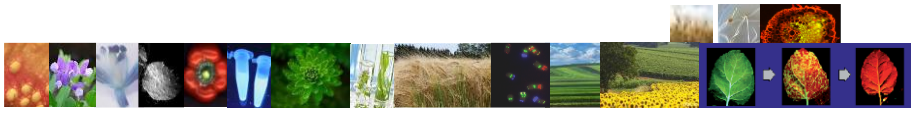
Continuous assessment CC 70% + oral examination EO 30%

Session 2:

Oral examination EO 100%

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Intitulé UE/ECUE	**Physiologie des Systèmes (Paris Cité)** **Optional course unit E, option 1**	
Type d'UE/ECUE	UE à choix, parcours PAPH et SV	
Responsable de l'UE/ECUE	A. Diet/ G. Gangarossa	
Semestre	M1S2	
Nombre d'ECTS	3	
Lieu, organisation	Paris Cité, 2 semaines (2 dernière semaines de janvier)	
Volume horaire présentiel étudiant	Nombre d'heures de CM : 12h Nombre d'heures de TD : 10h Nombre d'heures de TP : 12	
Objectifs en terme de connaissances	Analyser et intégrer les différents niveaux d'informations d'un organisme pour appréhender de façon globale et modéliser son fonctionnement en interaction avec l'environnement.	
Compétences visées	Intégrer et synthétiser des informations, argumenter pour défendre une hypothèse.	
Contenu de l'UE/ECUE	L'UE sera axée sur les communications/coopérations entre différents organes / systèmes pour une fonction biologique. L'accent sera mis sur l'intégration des données permettant de modéliser ces processus complexes. Les exemples seront issus des règnes animal et végétal : stratégies métaboliques en lien avec le développement et l'adaptation, interactions avec le microbiote, rythmes biologiques par exemple.	
Modalités de contrôle des connaissances	Session 1	contrôle continu 100% 100% Exposé basé sur un projet personnel
	Session 2	100% Épreuve orale



BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Plant-microbe interactions (Paris-Saclay)

Optional course unit E, option 2

Keywords

Plant-microorganism interactions; pathogenicity and symbiosis; molecular dialogue; epidemiology and crop protection/improvement.

Description of the course content

Plants interact with the microorganisms in their environment and must continually adapt to them. Microorganisms can therefore have negative (pathogenic) or beneficial (symbiotic) effects on plants in natural ecosystems and agro-ecosystems. This issue is particularly topical at a time when farming practices must maintain yields while protecting the environment.

Objectives:

- Acquire the knowledge and the methods needed to understand the dynamics of plant-microorganism interactions, whether pathogenic or symbiotic, in relation to environmental factors.
- Understand the molecular and cellular mechanisms involved in these interactions.
- Know the societal and ecological stakes of these interactions.
- Consider traditional and innovative control methods for improving the quality and the yield of agricultural production.

Number of ECTS credits

4 ECTS

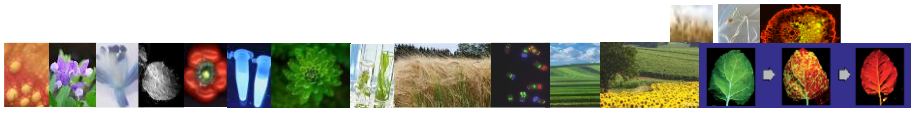
Skills to be acquired

- Master the main infection processes of pathogenic microorganisms and their specific features, in relation to the different parasitic strategies.
- Master the main immune mechanisms of plants (mechanisms of microorganism perception, signaling and defence).
- Understand the epidemiological factors explaining the emergence and the spread of a disease at different spatial and temporal scales.
- Be able to describe the control methods used in crop protection.
- Be able to describe the diversity of symbiotic interactions in plants and the molecular dialogue between the microbiota and the host plant, and to discuss the ecological and societal importance of symbiotic interactions.
- Be able to name the niches of the plant microbiota and to describe how the plant microbiota becomes established.
- Be able to implement the main plant pathology techniques.

Additional skills:

- Be able to analyze a scientific paper and to produce a synthesis on a scientific topic.
- Be able to search the scientific literature for information.
- Be able to communicate a scientific message in English, orally or through a scientific communication medium.

Organization and monitoring arrangements:



The course unit comprises 9 h of lectures on interactions between plants and pathogenic microorganisms (fungi, bacteria, viruses), 3 h of lectures on interactions between plants and symbiotic microorganisms, and 1.5 h of lectures on the plant microbiota and its interactions in the rhizosphere. Students are introduced to epidemiology (3 h of lectures) and receive teaching on plant immunity (6 h of lectures) and on methods of controlling phytopathogenic microorganisms (3 h of lectures). The teaching is completed by an analysis of papers on the theme of symbiosis (1.5 h of tutorials) and by 9 h of practicals during which students apply plant pathology techniques and concepts to study the level of susceptibility/resistance of two plant genotypes (wild type and mutant) to different pathogens, and discuss the role of the altered function in the immunity of these plants. Throughout the unit, students work in teams on a plant pathology topic in order to produce an oral synthesis of it, based on a scientific poster.

Prerequisites

Bachelor's-level knowledge in life sciences of the biology of microorganisms (fungi, bacteria, viruses) and of plants, as well as of molecular biology and genetics.

Description of the teaching team

Coordinator:

Marie Garmier, Associate Professor, Université Paris-Saclay (marie.garmier@universite-paris-saclay.fr)

Other members of the teaching team:

Alia Dellagi, Professor, AgroParisTech; Marie Dufresne, Professor, Université Paris-Saclay; Camille Fonouni-Farde, Associate Professor, Université Paris-Saclay; Eoghan King, Associate Professor, AgroParisTech; Stéphanie Pflieger, Associate Professor, Université Paris Cité; Ivan Sache, Professor, AgroParisTech

Main teaching language

English

Total teaching hours

Lecture hours: 25.5 h
Total practical hours: 9 h
Total tutorial hours: 1.5 h

Teaching period and course location

Period: Semester 1 – second half of January
Location: IPS2 building 630, Université Paris-Saclay, avenue des Sciences, Plateau du Moulon

Assessment method

Session 1:

Oral presentation of work on paper(s) or of a literature review (with slides or poster): 30% (at the end of the unit); written exam (2 h): 70%.

Session 2:

100% written exam (2 h)

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Metagenomics and microbial molecular ecology

(Paris-Saclay)

Optional course unit F, option 1

Keywords

Microbial ecosystems, molecular ecology, bioinformatics, practical teaching

Description of the content of the teaching

Knowledge and implementation of molecular and bioinformatic tools for the analysis of microbial ecosystems using metagenetic approaches (e.g. 16S gene amplicon sequencing; or other markers depending on the microbial ecosystem studied). Knowledge of the principles of descriptive and functional microbial ecology. The course will aim to compare several samples taken either from a food microbial ecosystem, from environmental microbiota or plant, human or animal digestive microbiota, or from biotechnological digesters used to treat bio-waste. Descriptive and functional knowledge of these ecosystems will be presented in lectures, and the acquisition of the skills necessary for data processing will be addressed in tutorials and practicals. Emphasis will be placed on the critical study of the different stages of analysis using bioinformatics tools that are easy for microbiologists to use and implemented on a Galaxy interface or R biostatistics packages specific to molecular ecology studies (e.g. Phyloseq package).

Prerequisites: Basic knowledge in microbial taxonomy, in biostatistics and in the use of R language

Number of European credits

4 ECTS

Skills to be acquired

At the end of the unit the students will have complete independence and autonomy to compute and analyse 16S- amplicon sequencing metagenomic data from various microbial ecosystems.

Organisational and monitoring arrangements

Face-to-face (lectures; tutorials; practicals).
Skills will be acquired during tutorials using test data sets, then put into practice on unknown data sets, the analysis of which will form part of the assessment.
Opening an account on the Migale bioinformatics platform in Jouy-en-Josas.

Teaching team

Coordinators:
Stéphane Chaillou Researcher, INRAE (stephane.chaillou@inrae.fr)
Eoghan King, Associate Professor, AgroParisTech (eoghan.king@agroparistech.fr)

Main teaching language

English

Overall timetable

Lectures: 18h
Tutorials: 18h
+ project to be carried out autonomously: 20h

Teaching period and location of courses

Period: Semester 2 – March
Location: AgroParisTech, Palaiseau campus

Knowledge test mode

Session 1:
Oral examination EO (oral presentation on the data analyses project) 100%
Session 2:
Written examination EE 100%

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Les semences : de la biologie à la filière (Paris-Saclay)

UE à choix F, option 2

Mots clés

Germination ; Production agricole ; Dormance ; Filière ; Graines ; Semences ; Longévité ; Contrôles de qualité ; Technologie des semences

Description du contenu de l'enseignement

Objectifs :

La graine est l'unité de dispersion et de propagation des plantes à fleurs (angiospermes). Elle contient et protège l'embryon végétal jusqu'à la germination. La France est un acteur majeur sur le marché semencier au plan international. En effet, elle se place au 1er rang européen pour la production et au 1er rang mondial pour l'exportation des semences. La France doit cette position à des sols et des conditions climatiques largement favorables mais aussi aux efforts constants des producteurs et de toute la filière française des semences.

La qualité des graines constitue donc un grand intérêt agronomique. En effet, la qualité de la production agricole est totalement dépendante de la qualité des semences. Elles symbolisent aujourd'hui un des vecteurs essentiels du progrès scientifique et technique en agriculture et représentent de ce fait des enjeux économiques, sociaux et environnementaux considérables. L'objectif de l'unité d'enseignement est d'illustrer quelques thématiques modernes de la biologie des semences en soulignant leur potentiel d'application et de présenter les principaux acteurs et le fonctionnement de la filière semences. Pour ce dernier point, il est fait appel à des spécialistes de la profession (GEVES, GNIS, INRAE, secteur privé).

Contenu :

A - Connaître la semence : Biotechnologies ; Physiologie du développement des semences ; Contrôle de la dormance, de la germination et de la longévité des semences ; Pathologies des semences.

B - La filière semences et la qualité : Production, préparation, conditionnement et conservation des semences ; La mise en place de la qualité des semences ; Le contrôle de la qualité des semences, les règles internationales d'essais de semences.

C - Economie des productions de semences : Les semences dans le monde et la filière française ; Enregistrements des variétés et protection des semences ; Le marketing dans le secteur semences.

Nombre de crédits européens

4 ECTS

Compétences à acquérir

Physiologie et Biotechnologie des semences, Techno-semences, Marché des semences, Gestion des rendements, Aide à la décision de l'itinéraire cultural, Connaissance de la filière semences.

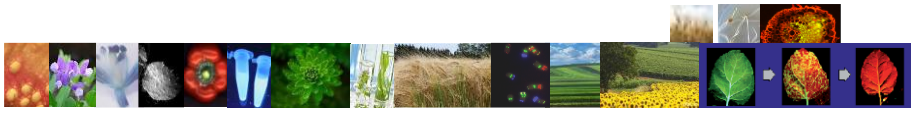
Description de l'équipe enseignante

Coordinateur:

Loïc Rajjou, Pr AgroParisTech (Production végétale) (loic.rajjou@agroparistech.fr)

Langue principale d'enseignement

Français



Volume horaire global

Volume horaire de cours : 12h
Volume horaire global de TD : 14h
Volume horaire pour projet tutoré : 10h

Période d'enseignement et localisation des cours

Période: Semestre 2 – dernière semaine de février – (salon international de l'agriculture) - 2ème semaine de mars
Lieu : AgroParisTech, campus de Palaiseau

Mode de contrôle des connaissances

Session 1 :
Contrôle continu (dossier) CC 30% + Exposé oral (en binôme ou en trinôme) EO 70% ; prise en compte de la participation et assiduité
Session 2 :
100% examen écrit

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Genome engineering and RNA interference (Paris Cité)

Optional course unit G, option 1

Keywords

Genome editing, RNA-based gene regulation, synthetic biology

Description of the content of the teaching

Objectives:

The objective of this course will be to explore the methodologies of genome engineering, RNA interference and synthetic biology and to understand their underlying fundamental biological mechanisms. Challenges in medicine and agronomy, as well as ethical/legal issues, will be discussed.

Content:

1rst week: lectures (8h), tutorials (7h) on genome editing, RNA interference (and other RNA-based technologies) and synthetic biology. Several seminars (one hour each) could be given by researchers, platform engineers and professionals from private companies, specialized in one of these fields.

2nd week: a 5-day practical course (21h) focused on RNA interference mechanisms and applications in plants. During this practical course, students will analyse different Arabidopsis lines, that are silenced or not, for a reporter transgene. For that, they will carry on several experiments, that are commonly used to estimate the efficiency of a RNAi approach and to analyse small RNAs: RT-qPCR, DNA methylation analysis, dedicated northern for small RNAs, tissue and subcellular localisation of proteins using fluorescence microscopy, …

The course will include a 1h30-seminar involving the analysis of scientific articles on symbiosis, and 9h of practical work during which students apply techniques and concepts from plant pathology to assess the susceptibility/resistance of two plant genotypes (wild type and mutant) to various pathogens, and discuss the role of the altered function in plant immunity.

Number of European credits

4 ECTS

Skills to be acquired

At the end of the course, students will be able to:

- Design an adequate strategy of RNAi or genome editing, using CRISPR-Cas or other technologies
- Understand the design of regulatory circuits or metabolic pathway in synthetic biology
- Be aware of the recent fields of applications and ethical issues of these biotechnologies
- Gain autonomy in basic molecular and cellular biology technics used to validate the efficiency of a RNAi constructs and/or to analyse small non coding RNAs
- Organize themselves (or by two) to perform several experiments in parallel, like in labs
- Collaborate inside a working team
- Analyse, criticize and present their experimental results (oral and written report)
- Integrate results obtained by different scales of analysis (from DNA to the plant level) to answer a complex biological question

Associated bibliography

- Biotechnologies. Les promesses du vivant, 2015, Vanessa Proux, Collectif, Fyp
-Stable RNA interference rules for silencing, Fellmann and Lowe, 2014, Nature Cell Biology, vol 16 - https://www.cell.com/nucleus-CRISPR - Synthetic biology: Recent progress, b.

Teaching team

Coordinators

Christine Lelandais Associate Professor, Université Paris Cité (christine.lelandais@u-pariscite.fr)
Céline Sorin Associate Professor, Université Paris Cité (celine.sorin@u-pariscite.fr)

Main language of teaching

English

Overall timetable

Lectures: 8h
Tutorials: 7h
Practical course: 21h
Total number of teaching hours: **36h**

Teaching period and location of courses

Period: Semester 2 – 2 last weeks of March
Location: Université Paris Cité - Grands Moulins campus

Knowledge test mode

Session 1:
continuous assessment CC 100% (including written report of the practical course)
Session 2:
30% first term CC mark (retained) + oral examination EO 70%

BCC3 : Plant sciences 2: specialised knowledge and innovative methods for sustainability

Physiologie de la nutrition et agronomie (Paris-Saclay)

UE à choix G, option 2

Mots clés

Physiologie plante entière ; Rendement et qualité des cultures ; Nutrition minérale et carbonée : de la plante entière à la parcelle

Description du contenu de l'enseignement

Prérequis :

Bases de physiologie et de métabolisme chez les plantes niveau licence sciences de la vie.

Objectifs :

Caractériser la physiologie de la nutrition minérale et carbonée à l'échelle de la plante entière et de la parcelle.

Contenu :

Cette UE est structurée en trois parties :

1. Introduction à la nutrition azotée et carbonée

   Présentation des bases de la nutrition minérale des plantes et des enjeux actuels en agronomie, notamment la réduction des pollutions des sols, l'optimisation de la fertilisation et l'adaptation de la nutrition des espèces cultivées aux changements climatiques.

2. Travaux pratiques en laboratoire

   Mise en œuvre des principales techniques de physiologie végétale permettant de quantifier la nutrition azotée et carbonée. Ces séances visent à familiariser les étudiants avec les méthodes d'analyse utilisées en recherche et en agronomie expérimentale.

3. Travaux pratiques au champ

   Mesure des teneurs en azote dans des plantes cultivées en conditions réelles. L'objectif est de montrer comment ces données permettent d'améliorer la gestion des engrais et la durabilité des systèmes de production.

Modalités d'organisation et de suivi

- **CM :** Nutrition minérale (azote, phosphore, absorption, assimilation, remobilisation) ; Photosynthèse et bilan de carbone ; Plantes modèles (Arabidopsis, Medicago, Brachypodium) et plantes cultivées (Colza, Maïs, Blé …) ; Cycle de l'azote, carbone et eau à l'échelle de la parcelle, étude des sols ; Relation entre la fertilisation et le rendement (qualité des graines, biomasse)
- **TD :** Quantification des glycomolécules par spectroscopie de masse, méthode des bilans en agriculture, visite de la Digiferme d'Arvalis.
- **TP au champ :** mesures non destructives NDVI sur le site d'Arvalis de Villiers le Bâcle, prélèvements en champ des échantillons, mesures de poids frais et secs.
- **TP au labo :** Phénotypage d'Arabidopsis sauvages et mutantes affectés dans le transport des sucres pour les métabolismes azotés et carbonés (Dosage enzymatique des sucres solubles et des acides aminés, coloration lugol pour la détection d'amidon)

Nombre de crédits européens

4 ECTS

Compétences à acquérir

- Comprendre et maitriser les connaissances et les outils permettant d'analyser le fonctionnement d'une plante entière
- Avoir conscience des grands enjeux agronomiques en lien avec la nutrition des plantes et de la gestion des itinéraires culturaux dans un souci de production durable
- Suivre rigoureusement un protocole expérimental
- Présenter et analyser des résultats expérimentaux

Bibliographie associée

Botanique : Biologie et physiologie végétales de Sylvie Meyer, Catherine Reeb, Robin Bosdeveix, Edition Maloine.
Biologie végétale : Nutrition et métabolisme de Jean-François Morot-Gaudry, François Moreau, Roger Prat, Christophe Maurel, Hervé Sentenac, Edition Dunod.

Description de l'équipe enseignante

Coordinatrices :
Sophie Filleur, MCF Paris Cité (*sophie.filleur*@u-pariscite.fr)
Rozenn LE HIR, CR INRAE IJPB (rozenn.le-hir@inrae.fr)

Langue principale d'enseignement

Français

Volume horaire global

Volume horaire de cours : 8h
Volume horaire global de TP : 21h
Volume horaire global de TD : 7h

Période d'enseignement et localisation des cours

Période :
Semestre 2 – 2 dernières semaines de mars
Lieu :
INRAE Centre de Versailles- Institut Jean-Pierre Bourgin IJPB

Mode de contrôle des connaissances

Session 1 :
Contrôle continu CC 100%
Un exposé oral en fin de période d'enseignement sur les résultats obtenus en TP, sous forme d'un diaporama rédigé en anglais, par binôme + un cahier de laboratoire rédigé en anglais + une analyse d'article
Session 2 :
Contrôle continu CC (conservé de la session 1) 30% + examen oral 70%

BCC4 : Implementing a plant science research and innovation project in a professional context

Internship

Keywords
Professional experience; internship search; introduction to experimental practice; literature search and review; data analysis; project management

Course content and teaching objectives
- Carry out an active internship search; write a CV and a cover letter; attend an interview
- Contribute to a research project by integrating into a team while showing autonomy and initiative;
- Apply a scientific approach to answer a given research question;
- Collect, analyze and synthesize information from the literature;
- Analyze and present experimental results orally and in writing.

Number of ECTS credits
8 ECTS

Organization and monitoring arrangements
Internship in a laboratory or in a company, in France or abroad
One mentor per student (to support the internship search and to provide guidance during the internship)

Description of the teaching team
Coordinator:
Bertrand Gakière, Associate Professor, Université Paris-Saclay (bertrand.gakiere@universite-paris-saclay.fr)

Other members of the teaching team:
Karine Alix, AgroParisTech; Axel de Zélicourt, Université Paris-Saclay; Gianluca Teano, UEVE; Sarah Ben Sadoun, AgroParisTech; Sophie Filleur, Université Paris Cité; Anouck Diet, Université Paris Cité; Yves Deveaux, Université Paris-Saclay; Jean-Denis Faure, AgroParisTech; Pierre Gérard, AgroParisTech; Eoghan King, AgroParisTech; Ariane Gratias-Weill, Université Paris-Saclay; Céline Charon, Université Paris-Saclay; Natalia Conde e Silva, Université Paris-Saclay; ...

Total contact hours:
8-week internship

Internship period
from late April to late June

Assessment method
Session 1:
Written report (40%, in French or English) and oral defence (60%, presentation in English)
Session 2:
Written report (40%, in French or English) and oral defence (60%, presentation in English)
Report + defence: see the instructions provided during the year