COURSE DATA

Data Subject	
Code	36352
Name	Plant Biotechnology and Human Health
Cycle	Grade
ECTS Credits	4.5
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Faculty of Biological Sciences	4	First term

Subject-matter

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	14 - Materia de asignaturas optativas	Optional

Coordination

Name	Department
MARCO PICO, FRANCISCO	25 - Plant Biology
MUÑOZ BERTOMEU, JESUS	25 - Plant Biology

SUMMARY

Plant biotechnology and human health is an optional subject of the Degree in Biochemistry and Biomedical Sciences. The theoretical and practical content, together with the activities carried out during the course, have been designed considering two fundamental aspects. Firstly, to provide the knowledge that students must acquire about Plant Biotechnology and its relationship with human health and, secondly, to avoid overlapping with other core and optional subjects of the Degree. In this sense, the students have previously taken a compulsory subject in the third course on Plant Molecular Biology, where some notions of in vitro culture and genetic transformation of plants are taught in some subjects.

Plants are not only the main primary producers that allow life on this planet, but they also produce and accumulate a wide variety of compounds that can be useful for the treatment of ailments and diseases. Starting from this basis, a first section of the program will discuss aspects related to the concept of medicinal plants and plant drugs, and how plants can be or can be converted into biofactories to produce certain drugs.

In a second section we will address aspects of secondary metabolism of plants, which allows the manufacture of a wide variety of compounds that can be used to improve human health. These products will be classified, their possible functions will be studied, and their biosynthetic routes will be studied in order to understand the different possible strategies that make plants more efficient in the production and accumulation of these secondary metabolites.

Both classical improvement and improvement by biotechnological procedures are necessary and complementary. Therefore, a third section is devoted to the contributions of in vitro culture of plant cells and tissues to plant improvement, as well as to the different methods of genetic transformation of plants. This section will be complemented by the content of several practical classes.

The fourth and final section is devoted to the different applications of plant genetic manipulation, fundamentally related to obtaining secondary metabolites by in vitro systems, the use of transgenic plants and their cultivation for the pharmaceutical industry, and how plant foods can be biofortified, among other applications.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Relationship with other subjects of the same degree: No enrollment restrictions have been specified with other subjects in the study plan.

OUTCOMES

1109 - Degree in Biochemistry and Biomedical Sciences

- Have capacity for analysis, synthesis and critical reasoning in the application of the scientific method.
- Be able to think in an integrated manner and approach problems from different perspectives.
- Be able to use new information and communication technologies.
- Know the usual procedures used by scientists in the area of molecular biosciences and biomedicine to generate, transmit and disseminate scientific information.
- Know how to design multidisciplinary experimental strategies in the field of molecular biosciences to solve complex biological problems, especially those related to human health.
- Acquire skills to use the methodologies of molecular biosciences and to keep an annotated record of activities.
- Know the structural and functional characteristics of macromolecules.

- Know and understand the molecular bases of genetic information and the mechanisms of its transmission and variation.
- Have an integrated view of normal and altered cell function, including metabolism and gene expression.
- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Be able to assimilate scientific texts in English.

LEARNING OUTCOMES

English version is not available

DESCRIPTION OF CONTENTS

1. Unit 1. Introduction.

Concept of medicinal plant and plant-based drug. The plant as a drug-producing biofactory. Biotechnological tools to improve bioproduction in plants.

2. Unit 2. Concept of secondary metabolism.

Relationship with primary metabolism. Classification of secondary products. Cell compartmentalization. Distribution and storage of secondary products.

3. Unit 3. Biosynthesis of secondary metabolites: Phenolic compounds, terpenes, glycosides and nitrogenous compounds.

Phenols: shikimate pathway and acetate-malonate pathway. Terpenes: acetate-mevalonate and MEP pathways. Products of the metabolism of nitrogen-containing compounds. Basic principles of alkaloid biosynthesis. Glycoside synthesis: glucosinolates.

4. Unit 4. Functions of the products of secondary plant metabolism.

Physiological functions. Interactions of plants with their environment. Importance of secondary products in food and as active ingredients in pharmacy

5. Unit 5. In vitro culture fundamentals. Cell and tissue culture.

In vitro culture Fundamentals. In vitro culture types. In vitro culture requirements. Micropropagation. Morphogenesis and embryogenesis. Somaclonal variation. Cell and tissue cultures.

6. Unit 6. Protoplasts, somatic hybridization and genetic transformation.

Protoplast cultures and somatic hybridization. Genetic transformation of protoplasts

7. Unit 7. Genetic transformation of plants.

Direct transformation: biolistic. Indirect transformation: Agrobacterium tumefaciens. Mechanisms of infection and integration of foreign genes. Binary plasmid. Expression module. Transformation markers. Stable and transitory expression. Chloroplast transformation.

8. Unit 8. Significance of transgenic plants.

First, second and third generation transgenic plants. Advantages and disadvantages of using transgenic plants. Possible risks

9. Unit 9. Metabolic engineering of secondary metabolites in plants.

Metabolic engineering strategies of secondary metabolites in plants. Obtaining secondary metabolites of therapeutic or nutritional interest using in vitro systems.

10. Unit 10. Transgenic plants in the pharmaceutical industry.

Transgenic plants as a production system for molecules of therapeutic interest: drugs, vaccines, and antibodies. Advantages and disadvantages of using plants as biofactories of therapeutic products.

11. Unit 11. Transgenic plants in the food industry and other uses.

Fortified foods. Food biofortification through transgenic crops. Bioremediation.

12. Laboratory classes

Unit 12. Practical contents
1. Preparation and sterilization of media for different in vitro cultures. Disinfection and culture systems of plant material.
2. Obtaining plants by direct morphogenesis (foliar). Cellular dedifferentiation and indirect morphogenesis.
3. Propagation by axillary buds and acclimatization of plants obtained by in vitro culture.
4. Obtention of transgenic plants and analysis of marker gene expression.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	33,00	100
Laboratory practices	12,00	100
Development of group work	10,00	0
Study and independent work	27,50	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

Theory classes: The classes will consist of one-hour lectures in which the teacher transmits the knowledge of the subject orally, using the most recommended resources and didactic material for the subsequent preparation of the topic in depth. In some classes, the participatory model will be used, prioritizing communication between students and between students and lecturer.

Laboratory sessions: There will be 3 compulsory 4-hour sessions where the different proposed experiments will be carried out.

Seminars: the critical analysis of scientific articles selected by the lecturers of the subject will be carried out. This activity allows to the student to continue with the activity of reading of scientific works that has already been started in previous courses. This compulsory activity will be organized in pairs of students who will have to prepare a small dossier on the article in question and an exposition of it. After the presentation, a question time will be opened for the students to demonstrate that they have understood the topic(s) addressed in the article. During the seminar preparation, the students will be supervised by the lecturers through office tutorials.

EVALUATION

The subject will be evaluated with the sum of the following items:

- Seminar. The preparation of the dossier, the exhibition and its defense will be worth 1 point
- Theory. The value of this part will be up to 7 points, where 50% will be continuous evaluation (completion of questionnaires) and the rest will be evaluated through a final exam.
- Laboratory: Regarding the practical part, it will have a value of 2 points, and it will be evaluated by means of a memory of the work done during the laboratory sessions (1.5 points).Also, the attitude and aptitude will be evaluated during the realization of experiments with up to 0.5 points.
- A minimum of 5 points is required to pass the course. Also, it is necessary to obtain at least 40% of the maximum grade in each of the following parts: seminar, laboratory and final theory exam.

REFERENCES

Basic

- Azcón-Bieto J, Talón M (eds) 2008. Fundamentos de Fisiología Vegetal. Interamericana McGraw-Hill.
Taiz L, Zeiger E, Moller IM, Murphy A. 2015. Plant Physiology and Development. SinauerAssoc./Oxford University Press, 6th ed. Existe una traducción al castellano en su 3ª ed. publicada por la Universitat Jaume I de Castelló.
Buchanan B, Gruissem W, Jones R. 2015. Biochemistry & molecular biology of plants, 2 ed.American Society of Plant Biologists. Wiley-Blackwell,
Heldt HW, Piechulla B. 2016. Plant Biochemistry. Elsevier-Academic Press, 4th ed
Chahal GS, Gosal SS. 2002. Principles and Procedures of Plant Breeding. Biotechnological and Conventional Approaches. Alpha Science International, Pangbourne
George EF, Hall MA, De Klerk GJ. 2008. Plant Propagation by Tissue Culture. Vol 1, TheBackground. 3rd Ed. Springer, Dordrecht.
Kirakosyan A., Kaufman PB. 2009. Recent advances in Plant Biotechnology. Springer, Dordrecht.
Pérez-Solsona J, Cornejo-Martín MJ. 2014. Cómo y por qué trabajamos con células vegetales / Howand why we work with plant cells. Educació. Laboratory Materials 64. PUV, Universitat de Valéncia.
Slater A, Scott NW, Fowler MR. 2008. Plant Biotechnology. The genetic manipulation of plants.Oxford University Press, Oxford
Smith AM et al. 2010. Plant Biology. Garland Sciences, New York.
Steward CN. 2012. Plant Biotechnology and Genetics: Principles, Techniques and Applications. Wiley, Hoboken.
Revistas: Plant Biotechnology Journal, Metabolic engineering, etc.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1 y 2) Contenidos y Volumen de trabajo.

Sin cambios.

3) Metodología.

El punto de inicio dado el número de estudiantes y las aulas disponibles es de plena presencialidad en las actividades. Sin embargo, ante la posibilidad de que la evolución de la situación derivada de la COVID-19 obligue a una reducción de la presencialidad, se tomarán las siguientes medidas:

1) Las actividades presenciales en aula podrán ser sustituidas en función de las herramientas tecnológicas disponibles en el aula en el momento de desarrollo del curso, por las siguientes metodologías:

-Videoconferencia síncrona

-Presentaciones Powerpoint locutadas en Aula Virtual

2) Las actividades presenciales de prácticas de laboratorio, podrán ser sustituidas por las siguientes metodologías:

- prácticas de laboratorio simuladas mediante videoconferencia

- Trabajo con datos experimentales suministrados

- Discusiones en foros asíncronos en Aula Virtual

- Visionado de videos realizados en los laboratorios de prácticas

3) Para tutorías y dudas se podrán utilizar las siguientes metodologías:

-Chats síncronos en Aula Virtual

-Foros asíncronos en Aula Virtual

-Comunicación directa profesor-estudiante a través del correo institucional

-Videoconferencia síncrona

4) Evaluación.

En caso de que los exámenes no pudieran ser presenciales, se realizarían ‘on line’ en Aula Virtual mediante las herramientas disponibles.

En caso de que no se puedan realizar prácticas en los laboratorios, el 5% de la nota relacionado con la evaluación de la aptitud y actitud en el laboratorio podrá ser añadido a la memoria de prácticas, o ser sustituido por cuestionarios on line.

Los detalles concretos de la adaptación a las situaciones que se pudieran producir se supervisarán por la CAT y se comunicaran a los estudiantes a través de Aula Virtual