

28920 - Biotechnology

Syllabus Information

Academic Year: 2022/23

Subject: 28920 - Biotechnology

Faculty / School: 201 - Escuela Politécnica Superior

Degree: 583 - Degree in Rural and Agri-Food Engineering

ECTS: 6.0

Year: 3

Semester: First semester

Subject Type: Compulsory

Module:

1. General information

1.1. Aims of the course

Main objective of this syllabus is that students will know the basis of biotechnology and also the techniques that are nowadays applied in food production and agrarian processes. Students will be able to perform basic laboratory techniques commonly employed by plant (DNA purification, amplification of molecular markers by PCR, in vitro culture, etc.) and animal (semen quality assessment, isolation and conservation of oocytes, etc.) biotechnologists.

2. Learning goals

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

Success rates in previous courses:

2018/19	2019/20	2020/21
54.17%	62.50%	78.95%

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning program designed for this course is based on studying the fundamental topics and basic tools which are needed to know, and know to use, the main biotechnologies that are nowadays applied in agronomy. To reach this, we have combined the conceptual expositions in theoretical classes and a set of practical experiences that will allow a better understanding of these techniques and also will show its applicability.

4.2. Learning tasks

The course includes the following learning tasks:

Participative lectures, 30 on-site hours. The program of the course encompasses 15 themes, which will be presented in 2 h sessions. These themes are grouped in three clearly differentiated main blocks: the first block deals with basic knowledge about molecular genetics and nucleic acids- based techniques, which will be related to its main applications in agronomy. The second block of themes cover fundamentals of plant biotechnology and the third one topic is biotechnology for animal production.

Practical classes in laboratory/computers?room, 30 on-site hours distributed in 15 sessions of 2 h. In each class, students

will perform a practical experience related to the theoretical program of the course. The practical work will consist in laboratory experiments (28 h) and computer-based technics (2 h).

Study for the written exam: professors will provide lecture notes and power-point slides with the information presented in the theoretical classes. They also will provide a list of references to support the autonomous work of the student (87 h).

To a better development of the learning process, professors will encourage students to use the individual tutorial sessions

Written and practical exams: 3 hours.

4.3. Syllabus

The course will address the following topics:

Block I. Foundations and techniques

Unit 1. Introduction and overall context

- Concept and evolution of biotechnology

- White biotechnology

- Red biotechnology

- Green biotechnology

- Biotechnology as a business ? patents

Unit 2. Foundations of biotechnological progress ? biochemistry and molecular biology

- Biotechnological molecules

- Proteins

- Nucleic acids

- Molecular genetics

Unit 3. Tools and techniques of molecular genetics (I)

- Isolation and purification of nucleic acids

- The first tools: endonucleases

- Genetic transformation

- Cloned DNA and recombinant DNA

- Vectors for storing DNA ? gene library

- In-vitro replication ? polymerase chain reaction

Unit 4. Tools and techniques of molecular genetics (II)

- Electrophoresis of DNA

- Real time PCR, quantitative PCR

- Isothermal amplification of DNA

- Reverse transcription

- DNA sequencing

Unit 5. Genomic tools

- Genome projects

- Genes and genomes

- Bioinformatics.

- Next generation sequencing. Resequencing genomes

Unit 6. Proteins and proteomics

- Purification and electrophoresis of proteins

- Sequencing proteins

- ELISA enzyme-linked immunosorbent assay

- Enzyme production and industrial applications

Block II. Plant biotechnology

Unit 7. In-vitro culture of plant tissues and organs

- Introduction ? concept and conditioning factors

- Foundations ? cell totipotency and development

- Phytohormones

- Somatic embryogenesis

- Plant organogenesis

Unit 8. Applications of plant micropropagation

- Multiplication of plants
- Plant propagation on an industrial scale
- In-vitro production of plant metabolites
- In-vitro conservation - cryopreservation
- Applications in plant genetic improvement

Unit 9. Genetic engineering of plants

- What is a transgenic plant?
- Genetic constructs for transforming plants
- Methods of plant transformation
- Confirmation of the transformation
- Applications of transgenic plants

Block III. Animal biotechnology

Unit 10. Biotechnology of animal reproduction I ? detection and synchronization of estrus

- Estrus detection techniques
- Estrus induction and synchronization techniques

Unit 11. Biotechnology of animal reproduction II ? artificial insemination

- Semen assembly methods
- Semen quality assessment
- Semen storage and preservation
- Insemination techniques
- Conditioning factors of the successful reproduction after insemination

Unit 12. Biotechnology of animal reproduction III ? embryonic technologies

- MOET programs
- In-vitro production of embryos

Unit 13. Applications of biotechnology in animal genetic improvement ? animal genetic engineering

- Imbalance of linkage and selection
- Gene and marker assisted selection
- Genomic selection
- Genome manipulation in animal genetic improvement
- Transgenesis as a tool in animal production

Unit 14. Biotechnological applications in animal feed

- Production and use of additives (enzymes, bacteria, yeasts, etc.) for animal feed
- Production and use of synthetic amino-acids

Unit 15. Biotechnological applications in animal diagnosis and health

- Hormonal diagnosis
- Diagnosis of diseases
- Vaccine production

Content of practical sessions

1. Protocol in the laboratory of plant biotechnology. Tools and equipment ? security and hygiene ? protocols ?preparation of basic solutions of molecular biology
2. Preparation of media for bacteria culture.
3. Isolation of DNA from plant leaves.
4. Amplification of DNA through PCR.
5. Electrophoresis of DNA.
6. Bioinformatics in plant genetics- Data bases - Design of primers.
7. In-vitro plant production ? organogenesis in tomato.
8. In-vitro plant production ? micropropagation of potato.
9. Protocol in the laboratory of animal biotechnology. Tools and equipment ? security and hygiene ? protocols ?preparation of basic solutions
10. Spermogram (1) ? classic assessment.
11. Spermogram (2) ? new semen analysis techniques.
12. Oocyte extraction and in-vitro embryo production.

13. Sex determination. Sperm sexing and sex determination in sperms and embryos
14. HUMECO Journey of Animal Reproduction.
15. Preservation of gametes and embryos.

4.4. Course planning and calendar

Calendar of on-site sessions.

Activity / Week	1	2 (1)	3 (2)	4 (3)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	T	
<i>Presential activity</i>																					62	
Theory	4	2	2	4	0	2	2	2	2	2	2	2	0	2	2							30
Problems														2								2
Laboratory practical		2	2	4	0	2	2	2	2	2	2	2	0	0	2							24
Assesment								2											4			6
<i>No presential activity</i>																						88
Individual work	2	4	4	0	8	4	4	2	4	4	4	4	8	4	4	8	8	8	4			88
TOTAL	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	0	0	8	8	0	150	

(1) Friday 23th september with monday planning

(2) Friday 30th september with tuesday planning

(3) Friday 2nd october with wednesday planning

4.5. Bibliography and recommended resources

- BB** Abecia Martínez, Alfonso. Manejo reproductivo en ganado ovino / Alfonso Abecia Martínez, Fernando Forcada Miranda . Zaragoza : Servet, [2010]
- BB** Chawla, H. S.. Introduction to plant biotechnology / H. S. Chawla . 3rd. ed. Enfield (NH) [etc.] : Science Publishers, cop. 2009
- BB** Fundamentos de las técnicas de biología molecular / Denis Tagu, Christian Moussard, editores ; traducción realizada por Josep M. Casacuberta . Zaragoza : Acribia, 2006
- BB** Luque Cabrera, José. Texto ilustrado de biología molecular e ingeniería genética : conceptos, técnicas y aplicaciones en Ciencias de la Salud / José Luque Cabrera, Ángel Herráez Sánchez . Barcelona [etc.] : Elsevier , D.L. 2008
- BB** Reprology : Controlar la reproducción es controlar el futuro[Archivo de ordenador] / M. Ennuyer... [et al.] . Libourne : CEVA Santé Animale, 2001
- BC** Benítez Burraco, Antonio. Avances recientes en biotecnología vegetal e ingeniería genética de plantas / Antonio Benítez Burraco . Barcelona [etc.] : Reverté, D. L. 2005
- BC** Ingeniería genética, laboratorio virtual de identificación de transgénicos. CD-Rom. UNED, 2010
- BC** Klug, William S.. Conceptos de genética / William S. Klug, Michael R. Cummings, Charlotte A. Spencer ; traducción y revisión técnica, José Luis Ménsua, David Bueno i Torrens . 8ª ed. Madrid [etc.] : Pearson, D.L. 2006
- BC** Kreuzer, Helen. ADN recombinante y biotecnología : guía para estudiantes / Helen Kreuzer, Adrienne Massey ; [traducción a cargo de María Isabel Mora y María Jesús Arrizubieta Balardi] . Zaragoza : Acribia, 2004

- BC** McKee, Trudy. Bioquímica : la base molecular de la vida / Trudy McKee, James R. McKee; [traducción : José Manuel González de Buitrago] . 1ª ed. en español, traducción de la 3ª ed. en inglés Madrid [etc.] : McGraw-Hill Interamericana, 2003
- BC** Razdan, M.K.. Introduction to plant tissue culture / M.K. Razdan . 2nd ed. Enfield : Science Publishers, cop. 2003
- BC** Smith, John E.. Biotecnología / John E. Smith ; traducción a cargo de Fernando Escrivá Pons... [et al.] . [1a. ed.] Zaragoza : Acribia, D.L. 2006

LISTADO DE URLs:

DNA from the Beginning is organized around key concepts
[<http://www.dnafb.org/>]

Dna Learning Center - Biology Animation Library
[<http://www.dnalc.org/resources/animations/>]

Oracle Foundation, Thinkquest Library
[<http://www.searchmagnified.com/?dn=thinkquest.org&pid=9PO6B1W9X>]

Organización Mundial de Sanidad Animal, OIE
[<http://www.oie.int/es/>]

The updated recommended bibliography can be consulted in:
<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28920>