# 60570 - Biotechnology in plant and animal breeding

**Información del Plan Docente**

| | |
|---|---|
| **Academic Year** | 2018/19 |
| **Subject** | 60570 - Biotechnology in plant and animal breeding |
| **Faculty / School** | 201 - Escuela Politécnica Superior |
| **Degree** | 546 - Master in Agricultural Engineering |
| **ECTS** | 6.0 |
| **Year** | 2 |
| **Semester** | First semester |
| **Subject Type** | Compulsory |
| **Module** | --- |

## 1.General information

## 1.1.Aims of the course

## 1.2.Context and importance of this course in the degree

## 1.3.Recommendations to take this course

## 2.Learning goals

## 2.1.Competences

## 2.2.Learning goals

## 2.3.Importance of learning goals

## 3.Assessment (1st and 2nd call)

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

## 4.Methodology, learning tasks, syllabus and resources

## 4.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as theory sessions, practice sessions and workshops.

## 4.2.Learning tasks

The course includes the following learning tasks:

- Theory sessions
- Practice sessions

# 60570 - Biotechnology in plant and animal breeding

- Workshops

## 4.3.Syllabus

The course will address the following topics:

Topic 1. Introduction to animal breeding

- 1.1. Objectives of animal breeding
- 1.2. Evolution of genetics and its application to animal science
- 1.3. Genomics and animal breeding

Topic 2. Inheritance of major traits in animal science

- 2.1. Examples of simple allelic series
- 2.2. Examples of multiple allelic series
- 2.3. Sex-linked inheritance
- 2.4. Examples of genetic anomalies

Topic 3. Fundamentals of population genetics

- 3.1. Genetic characterization of a population
- 3.2. Variation of allele frequencies under selection

Topic 4. Inheritance of polygenic traits

- 4.1. Variables to describe polygenic traits
- 4.2. Determinism in polygenic traits
- 4.3. Genetic variables of polygenic traits

Topic 5. Basic principles on selection within a breed

- 5.1. Concept of breed in animal production
- 5.2. Breeds in Spain
- 5.3. Objectives and criteria for selection
- 5.4. Selecting breeding

Topic 6. Estimates of additive value or indexation

- 6.1. Characterization of genetic indexes
- 6.2. Estimation of the elemental index
- 6.3. Estimation of the synthetic index

Topic 7. Application of **genetic indexes**

- 7.1. Cattle application
- 7.2. Pigs application
- 7.3. Birds application

Topic 8. **Expected Progeny Differences**

- 8.1. Relationship between genetic superiority and expected progeny differences
- 8.2. Parameters of expected progeny differences per year
- 8.3. Response to selection

Topic 9. Method of selection

- 9.1. Genomic selection

# 60570 - Biotechnology in plant and animal breeding

- 9.2. Selection by ancestors
- 9.3. Individual selection
- 9.4. Selection by colateral relatives
- 9.5. Progeny selection

Topic 10. Cross-breeding

- 10.1. Objective of cross-breeding
- 10.2. Types of cross-breeding

Topic 11. Plant breeding

- 11.1. Introduction
- 11.2. Registration of plant varieties
- 11.3. Genetic consequences of plant reproduction systems
- 11.4. Types of varieties

Topic 12. Breeding methods (I)

- 12.1. Objectives of plant breeding
- 12.2. Pure line breeding.
- 12.3. Backcrossing
- 12.4. Obtaining multiline varieties

Topic 13. Breeding methods (II)

- 13.1. Obtention of open-pollinated varieties
- 13.2. Obtention of synthetic varieties
- 13.3. Obtention of hybrid varieties
- 13.4. Obtention of clonal varieties

Topic 14. Applications of tissue culture techniques in plant breeding

- 14.1. Sanitary clonal selection
- 14.2. Somaclonal variation; in vitro induced mutagenesis
- 14.3. Embryo rescue
- 14.4. Obtention of haploid and doublé-haploid plants

Topic 15. Applications of plant genetic engineering

- 15.1. Transgenic varieties
- 15.2. Genetic improvement of abiotic stress tolerance
- 15.3. Genetic improvement of biotic stress tolerance
- 15.4. Genetic improvement of quality
- 15.5. Plant as biofactories
- 15.6. Legal regulation of transgenic varieties
- 15.7. Genome editing

Topic 16. Applications of random molecular markers

- 16.1. Molecular markers
- 16.2. Variety identification
- 16.3. Crossing and purity tests
- 16.4. Plant genetic diversity analysis

Topic 17. Mapping markers and genes

- 17.1. Linkage and cartography of markers. Maps

- 17.2. Mapping populations
- 17.3. Mapping major genes
- 17.4. Detection of QTLs
- 17.5. Marker assisted selection
- 17.6. Development of allele-specific markers

Topic 18. Applications of genome sequencing

- 18.1. Resequencing: SNPs markers
- 18.2. Platforms for mass-genotyping
- 18.3. Genotyping by sequencing
- 18.4. Genome wide association analysis
- 18.5. Genomic selection

Topic 19. Identification and characterization of genes (I)

- 19.1. Positional cloning
- 19.2. Cloning genes by sequence homology
- 19.3. Programs to predict genes
- 19.4. Reverse genetics strategies

Topic 20. Identification and characterization of genes (II)

- 20.1. Functional cloning
- 20.2. Genetic expression analysis
- 20.3. Proteomics
- 20.3. Metabolomics

**Practice sessions**

1. Breeding program of 'Frisona Española'
2. Breeding program in 'Raza Parda de Montaña'
3. Breeding program in 'Rasa aragonesa'
4. Breeding program in 'Gallina del Sobrarbe'
5. Breeding program in pork
6. Evaluation of quantitative traits in cultivated plants
7. Heritability. Selection
8. Genetic transformation of tomato
9. Analysis of genetic diversity in grapevine using SSR markers
10. Analysis of SNP markers in rice

## 4.4.Course planning and calendar

Provisional course planning

| Week | Theory | Practice session | Autonomous work | Total |
|---|---|---|---|---|
| **1** | Topic 1<br><br>Topic 2 | - | - | 4 |

# 60570 - Biotechnology in plant and animal breeding

| | | | | |
|---|---|---|---|---|
| **2** | Topic 3<br>Topic 4 | - | study (4 h) | 8 |
| **3** | Topic 5<br>Topic 6 | - | study (4 h) | 8 |
| **4** | Topic 7 | Practice session 1 | work (2 h)<br>study (2 h) | 8 |
| **5** | Topic 8 | Practice session 2 | work (2 h)<br>study (2 h) | 8 |
| **6** | Topic 9 | Practice session 3 | work (2 h)<br>study (2 h) | 8 |
| **7** | Topic 10 | Practice session 4 | work (2 h)<br>study (2 h) | 8 |
| **8** | Topic 11 | Practice session 5 | work (2 h)<br>study (2 h) | 8 |
| **9** | Topic 12<br>Topic 13<br>(Exam session) | - | study (4 h) | 8 |
| **10** | Topic 14 | Practice session 6 | work (2 h)<br>study (2 h) | 8 |
| **11** | Topic 15 | - | work (2 h) | 8 |

| | | | | |
|---|---|---|---|---|
| | Topic 16 | | study (2 h) | |
| **12** | Topic 17 | Practice session 7 | work (2 h)<br>study (2 h) | 8 |
| **13** | Topic 18 | Practice session 8 | work (2 h)<br>study (2 h) | 8 |
| **14** | Topic 19 | Practice session 9 | Work (2 h)<br>study (2 h) | 8 |
| **15** | Topic 20 | Practice session 10 | study (4 h) | 8 |
| **16** | - | - | study (8 h) | 8 |
| **17** | - | - | study (8 h) | 8 |
| **18** | - | - | study (8 h) | 8 |
| **19** | - | - | study (8 h) | 8 |
| **20** | Exam session | | | 2 |
| **Total hours** | 42 | 20 | 88 | 150 |

## 4.5.Bibliography and recommended resources


| | |
|---|---|
| **BB** | Benítez Burraco, Antonio. Avances recientes en biotecnología vegetal e ingeniería genética de plantas / Antonio Benítez Burraco . Barcelona [etc.] : Reverté, D. L. 2005 |
| **BB** | Brown, Jack. An introduction to plant breeding / Jack Brown, Peter D. S. Caligari . Oxford : Blackwell, 2008 |

# 60570 - Biotechnology in plant and animal breeding

| | |
|---|---|
| **BB** | Chawla, H. S.. Introduction to plant biotechnology / H. S. Chawla . 3rd. ed. Enfield (NH) [etc.] : Science Publishers, cop. 2009 |
| **BB** | Falconer, D. S.. Introducción a la genética cuantitativa / D. S. Falconer, Trudy F. C. Mackay ; [traducción realizada por Armando Caballero Rúa... (et al.)] . 1a., ed. en español, traducción de la 4a., ed. inglesa Zaragoza : Acribia, 2001 |
| **BB** | Los marcadores genéticos en la mejora vegetal / editores, F. Nuez, J.M. Carrillo . Valencia : Universidad Politécnica de Valencia, D.L. 2000 |
| **BB** | Nicholas, F.W.. Introducción a la genética veterinaria / F.W. Nicholas ; [traducción a cargo de Alfredo Ruiz Panadero,Arcadio Navarro Cuartiellas, Esther Beltrán Paula] Zaragoza : Acribia, 1998 |
| **BC** | Amélioration génétique des animaux d'élevage : Génome, caractères, sélection et croisements / Roland Jussiau... [et al.] . [3ème. éd.] Dijon : Educagri, cop. 2013 |
| **BC** | Avicultura clásica y complementaria / coordinador y director, Carlos Buxadé Carbó ; con la participación de 18 autores . Madrid [etc.] : Mundi-Prensa, 1995 |
| **BC** | Fundamentos de las técnicas de biología molecular / Denis Tagu, Christian Moussard, editores ; traducción realizada por Josep M. Casacuberta . Zaragoza : Acribia, 2006 |
| **BC** | Nicholas, F. W.. Introduction to veterinary genetics/ F. W. Nicholas . 2nd ed. Oxford: Blackwell Publishing, 2003 |
| **BC** | Ovino de leche : aspectos claves / con la participación de 34 profesionales ; coordinador y director, Carlos Buxadé Carbó . Madrid [ etc.] : Mundi-Prensa, 1997 |
| **BC** | Porcinocultura intensiva y extensiva / coordinador y director, Carlos Buxadé Carbó ; con la participación de 26 autores . Madrid [etc.] : Mundi-Prensa, 1996 |
| **BC** | Producción animal acuática / coordinador y director, Carlos Buxadé Carbó ; con la participación de 23 autores . Madrid [ etc.] : Mundi-Prensa, 1997 |
| **BC** | Producción caprina / coordinador y director Carlos Buxadé Carbó ; con la participación de 28 autores . Madrid [etc.] : Mundi-Prensa, 1996 |
| **BC** | Producción ovina / coordinador y director, Carlos Buxadé Carbó ; con la participación de 25 autores . Madrid [etc.] : Mundi-Prensa, 1996 |

# 60570 - Biotechnology in plant and animal breeding

| | |
|---|---|
| BC | Producción vacuna de leche y carne / coordinador y director, Carlos Buxadé Carbó ; con la participación de 23 autores . Madrid [etc.] : Mundi-Prensa, 1996 |
| BC | Producciones cinegéticas, apícolas y otras / coordinador y director Carlos Buxadé Carbó ; con la participación de 20 autores . Madrid [ etc.] : Mundi-Prensa, 1997 |
| BC | Producciones cunícola y avícolas alternativas / coordinador y director Carlos Buxadé Carbó . Madrid [ etc.] : Mundi-Prensa, 1996 |
| BC | Producciones equinas y de ganado de lidia / coordinador y director Carlos Buxadé Carbó . Madrid [ etc.] : Mundi-Prensa, 1996 |
| BC | Razdan, M.K.. Introduction to plant tissue culture / M.K. Razdan . 2nd ed. Enfield : Science Publishers, cop. 2003 |
| BC | Vacuno de carne : aspectos claves / coordinador y director Carlos Buxadé Carbó ; con la participación de 41 profesionales . Madrid : Mundi-Prensa, 1997 |
| BC | Vacuno de leche : aspectos claves / coordinador y director Carlos Buxadé Carbó ; con la participación de 35 profesionales . Madrid : Mundi-Prensa, 1997 |

The recommended bibliography can be consulted in: http://psfunizar7.unizar.es/br13/egAsignaturas.php?id=10732