

## 60570 - Biotechnology in plant and animal breeding

### Syllabus Information

**Academic Year:** 2020/21

**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
- 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
- 9.2. Selection by ancestors
- 9.3. Individual selection
- 9.4. Selection by collateral 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 random molecular markers**

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

**Topic 15. Mapping markers and genes**

- 17.1. Linkage and cartography of markers. Maps
- 17.2. Mapping populations
- 17.3. Mapping major genes
- 17.4. Mapping QTLs
- 17.5. Marker assisted selection

**Topic 16. Genome sequencing- derived markers**

- 16.1. Resequencing: SNP markers.
- 16.2. High throughput genotyping platforms.
- 16.3. Genotyping by sequencing.
- 16.4. Genome wide association studies.
- 16.5. Genomic selection.

**Topic 17. Marked genes, cloned genes**

- 17.1. Developing allele-specific markers
- 17.2. Cloning genes
- 17.4. In silico genomics
- 17.5. Transcriptomics, proteomics, metabolomics, phenomics

**Topic 18. Applications of tissue culture techniques in plant breeding**

- 18.1. Germplasm conservation
- 18.2. Sanitary clonal selection
- 18.3. Somaclonal variation; in vitro induced mutagenesis
- 18.4. In vitro selection
- 18.5. Embryo rescue
- 18.6. Obtention of haploid and doublé-haploid plants
- 18.7. Obtention of polyploid plants

**Topic 19. Applications of plant genetic engineering (I)**

- 19.1. Transgenic varieties
- 19.2. Genetic improvement of abiotic stress tolerance
- 19.3. Genetic improvement of biotic stress tolerance
- 19.4. Genetic improvement of quality
- 19.5. Plant as biofactories

**Topic 20. Applications of plant genetic engineering (II)**

- 20.1. Protoplast transformation
- 20.2. Obtaining mutants and genotypes with altered gene expression
- 20.3. Genome editing
- 20.4. Legal regulation of transgenic varieties

**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. Heritability. Selection
7. Analysis of genetic diversity in grapevine using SSR markers
8. Analysis of SNP markers in rice (2 sessions)
9. Genetic transformation of tomato.

#### 4.4.Course planning and calendar

Provisional course planning

Week	Theory	Practice session	Autonomous work	Total
1	Topic 1 Topic 2	-	-	4
2	Topic 3 Topic 4	-	study (4 h)	8
3	Topic 5 Topic 6	-	study (4 h)	8
4	Topic 7	Practice session 1	work (2 h) study (2 h)	8
5	Topic 8	Practice session 2	work (2 h) study (2 h)	8
6	Topic 9	Practice session 3	work (2 h) study (2 h)	8
7	Topic 10	Practice session 4	work (2 h) study (2 h)	8
8	Topic 11	Practice session 5	work (2 h) study (2 h)	8
9	Topic 12 Topic 13 (Exam session)	-	study (4 h)	8

10	Topic 14	Practice session 6	work (2 h) study (2 h)	8
11	Topic 15 Topic 16	-	work (2 h) study (2 h)	8
12	Topic 17	Practice session 7	work (2 h) study (2 h)	8
13	Topic 18	Practice session 8	work (2 h) study (2 h)	8
14	Topic 19	Practice session 9	Work (2 h) 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
<b>Total hours</b>	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
- 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
- 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://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=60570>