Universidad Zaragoza

Academic Year/course: 2021/22

60570 - Biotechnology in plant and animal breeding

Syllabus Information

Academic Year: 2021/22
Subject: 60570 - Biotecnología y mejora vegetal y animal
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

2. Learning goals

3. Assessment (1st and 2nd call)

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 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. Plant molecular breeding. Random markers

- 16.1. Molecular markers
- 16.2. Variety identification
- 16.3. Crossing and purity tests
- 16.4. 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. Genoyping by sequencing.
- 16.4. Genome wide asssociation 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 double-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 plant-derived products quality
- 19.5. Plant as biofactories

Topic 20. Applications of plant genetic engineering (II)

- 20.1. Plastidial 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 barley: QTL mapping

9. Analysis of SNP markers in rice: GWAS
10. 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
	Topic 15		work (2 h)	

11	Topic 16	-	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
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

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 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

BB SOCIAS I COMPANY, R. La obtención de variedades?: desde la mejora clásica hasta la mejora genética molecular. [s. l.]: Centro de Investigación y Tecnología Agroalimentaria de Aragón, 2014. ISBN 9788483803202.

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 Los marcadores genéticos en la mejora vegetal / editores, F. Nuez, J.M. Carrillo. Valencia : Universidad Politécnica de Valencia, D.L. 2000

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?id=10732&p=1