COURSE DATA

Data Subject	
Code	33198
Name	Molecular techniques in genetic improvement
Cycle	Grade
ECTS Credits	4.5
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1102 - Degree in Biotechnology	Faculty of Biological Sciences	4	Second term

Subject-matter

Degree	Subject-matter	Character
1102 - Degree in Biotechnology	108 - Molecular techniques in genetic improvement	Optional

Coordination

Name	Department
ESCRICHE SOLER, BALTASAR	194 - Genetics

SUMMARY

The subject "Molecular techniques in genetic breeding" is taught in the elective module within the fourth year of the Biotechnology Degree program, and it deepens the basic knowledge about molecular markers and their inheritance, as well as notions of population genetics that will have been acquired in the core subject of the second year called "Genetics." Subjects like "Principles in genetically modified organisms" (core) and "Food Biotechnology" (elective) have descriptors with content that overlaps with the present subject, although specifically applied to animals or microorganisms. Thus, taking this into account, the subject has been primarily designed with a focused, non-exclusive but prioritized approach centered on plant genetic improvement. From this perspective, the subject has been coordinated with the subject "Plant Biotechnology" (elective), which has certain similar descriptors, so that, despite some repetition (both are elective subjects), each subject provides different intensifications.

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Students should start with a general knowledge of molecular biology and genetics. The objective of this subject is for the student to delve into basic aspects of genetic improvement techniques, primarily using molecular markers.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

OUTCOMES

1102 - Degree in Biotechnology

- Determinar los marcadores moleculares apropiados en procesos de mejora con fines biotecnológicos.
- Diseñar procesos de manipulación y obtención de productos biotecnológicos.
- Analizar a nivel molecular el resultado de la manipulación de un organismo.
- Diseñar y aplicar aproximaciones biotecnológicas en el campo de la Agroalimentación.

LEARNING OUTCOMES

- Determine appropriate molecular markers in improvement processes.Designing handling processes and obtaining genetically improved organisms.
- Analyzing process at the molecular level and the result of selection of an organism.Design and implement breeding approaches in the field of agroalimentación
- Capacity to work together when facing problematic situations collectively.
- Ability to argue with rational criteria, clearly differentiating what is debatable what are facts or scientific evidence.
- Analisis and synthesis capacity.
- Create a critical attitude that allows them to issue judgments and argued vigorously defend and tolerance.
- Transmit the knowledge acquired in the subject to other professionals and laymen adapting the appropriate language to address the subject receptor.
- Ability to get obtain adequate information with which to address the scientific issues that arise.
- Ability to build a comprehensive and organized written text
- Professional training.
- Much of the contents of the course aims to develop in students the ability to confront and solve problems related to DNA, genes and genetic improvement.

DESCRIPTION OF CONTENTS

1. Topics

1 Introduction. Genetic breeding. The variation. Genotype and Phenotype. The selection.

2 DNA markers. Introduction to the markers. First generation DNA markers (RFLPs and minisatellites). Second generation DNA markers (microsatellites, RAPDs, AFLPs, and SNPs). Third generation DNA markers and mass genotyping (microarrays, detection by allele-specific ligation, mass NGS sequencing). Choice of a marker.

3 Linkage analysis with molecular markers. Concept and analysis of linkage. Estimation of the recombination fraction. Logarithm of the odds.

4 Marker mapping. Genetic map. Assignment to linkage groups. Practical cases.

5 Genetic structure of populations. Hardy-Weinberg equilibrium. Deviations from H-W equilibrium. Estimation of genetic variability. Plant reproduction systems.

6 Genes and quantitative characters. Quantitative character modeling and model interpretation. Mapping populations. Demographic factors and selection.

7 Selection assisted by molecular markers. Detection of QTLs. Marker-assisted selection (MAS). Case studies.

8 Genomic techniques and genetic breeding. Introduction. New challenges for plant breeding. The Genomic Revolution. Genomic variability. GWAS. Genomic selection. Transcriptomic. Genome Editing.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	21,00	100
Laboratory practices	15,00	100
Tutorials	9,00	100
Development of individual work	22,50	0
Preparation of evaluation activities	20,00	0
Preparing lectures	22,00	0
Preparation of practical classes and problem	3,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The teaching of this subject will be carried out through the following methodological approaches: lectures, organized discussion sessions on the topics of the syllabus, tutorials, and laboratory activities.

The student is required to attend the theory classes, where they will be provided with an overview of the topic being covered, with special emphasis on key concepts. In the same session, the most appropriate resources for further exploration of the topic will be indicated, allowing the student to enhance their understanding. Regarding the practical classes, experiments will be designed to reinforce the concepts presented in the theory classes.

The subject is designed to include both on-site and non-presential work.

EVALUATION

The assessment of student learning will be conducted through the evaluation of the following components:

1. After finishing the classes, it will be an exam that account for the 60% of the final qualification of the subject. It will be an exam with two parts of theory and one of problems (exercises) in a single call that will be held in the classroom. A minimum score of 4 out of 10 must be obtained in each part to pass. For the final mark of the exam, the theory and problem marks (exercises) will be compensated as long as a minimum score of 4 out of 10 is obtained in each part, and the overall mark of the exam is equal to or greater than 5 out of 10. In the final mark of the exam, the theory counts for 60% and the problems for 40%.
2. Assessment of attendance (20%) and practical lab report (or practical evaluation in the laboratory if applicable) (80%). A minimum score of 4 out of 10 must be obtained for this component. This component is worth 30% of the final grade.
3. An optional written report of a research paper describing the use of molecular markers. This component is worth 10% of the final grade.

The final grade for the subject will be the sum of the scores obtained in the evaluation of the three aforementioned components (theory+problems, laboratory practicals, and optional research paper), contributing to the final grade in proportions of 60%, 30%, and 10% respectively. The course will be considered passed with a grade higher than 5 out of 10.

To pass the subject in the second examination period, students must pass a single theory and problem exam similar to the one described in component 1. If the student has obtained a score of 4 out of 10 or higher in the practical component (see component 2) and has earned some points in component 3, these points will be added to the exam score following the formula used in the first examination period. If the score for the exercises in component 2 is lower than 4 out of 10, the theory and problem exam will include questions related to the laboratory activities. In this case, the exam will have a maximum value of 9 points, to which the points from component 3 will be added.

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Additional

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