GENETICA E MIGLIORAMENTO GENETICO DELLE PIANTE AGRARIE A - L

12 CFU - 2° Semester

Teaching Staff

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LEARNING OBJECTIVES

- **Genetics**
  Main intent of the module of Genetics is to provide knowledge on the fundamentals of classical and molecular genetics. The proposed training will complement the knowledge given by the other module of the C.I. and by the other biological courses provided by Bachelor’s Degree in Biotecnology.

  Through the module of Genetics, students in Biotecnology , will acquire knowledge on the analysis of the mechanisms of Mendelian inheritance. Besides, they will acquire basic knowledge concerning DNA structure and organization and, addictionally, general principles of gene expression. The student understand the main methods of DNA analysis and its polymorphisms and they will begin to understand the way in witch many molecules involved in the genetic processes are used in biotechnology. Moreover, they will learn about different types of mutations and their relative phenotypic effects, as well as about ways in which spontaneous mutations arise and their role in the evolution process. Finally, students will acquire the ability of effectively communicating biological themes in a proper scientific language.

- **Plant breeding**
  The learning objective of the discipline "Plant breeding" is to transfer to the student knowledge and tools for the evaluation of natural and induced genetic variability for selective purposes. At the end

of the course, students will be able to:
● To plan a plant breeding program and to choose the most suitable procedures for the creation of new varieties by integrating the traditional procedures of genetic improvement with biotechnological tools.
● Understanding the genetic mechanisms underlying the evolution of plants and applying experimental designs in order to identify and select genotypes to obtain improved varieties.
● Organize and manage the genetic traceability processes of plant varieties throughout the entire production chain.

COURSE STRUCTURE

- **Genetics**
  Teaching will include interactive classroom lessons, during which powerpoint presentations and scientific videos will be introduced. At the end of each lesson, its effectiveness will be verified through the platform SOCRATIVE and students will be asked to answer 4 or 5 questions anonymously with their smartphone. Futhermore, Genetics' exercises classes will take place as well as 2 in itinere examinations. After revision, these tests will be discussed with the students. Should teaching be carried out in mixed mode or remotely, it may be necessary to introduce changes with respect to previous statements, in line with the programme planned and outlined in the syllabus.

- **Plant breeding**
  Teaching (6 CFU) includes lectures and exercises in the classroom. For lectures, the teacher will make use of power point presentations and videos, also in English. The exercises will consist of solving problems and exercises on the covered topics, also by applying appropriate statistical tests and availing of the SOCRATIVE platform. If the teaching is given in a mixed or remote mode, the necessary changes will be introduced, in order to respect the program reported here. Learning assessment might also be carried out remotely, should the conditions related to Covid-19 epidemiological emergency require it. .

DETAILED COURSE CONTENT

- **Genetics**
  Mendelian inheritance. Genotype and phenotype. Monohybrid and dihybrid cross. Relations between the alleles: complete and incomplete dominance, co-dominance and recessivity. Multiple alleles. The Epistasis. Mitosis: chromosome configuration at different stages of the cell cycle. Meiosis: random assortment of chromosomes, crossing-over and gametes formation. Haploidy and diploidy. The Chromosomal theory of heredity: the Morgan experiments. Gene linkage and genetic mapping. Probability and statistics to analyze the transmission of Mendelian traits. The chi-square test. The pedigree analysis in the study of inherited traits.

  The genetic molecules. Experiments to identify the genetic material: Griffith, Avery-McLeod-MacCarty, Hershey and Chase. The structure of DNA and RNA molecules. Characteristics of the genome in the present organisms. Organization of Eukaryotic chromosomes. The human karyotype: main methods to preparation and analysis.

  Mutations. Mutations in somatic and germ cells. Point mutations: characteristics and effects.

Molecular basis of mutations. Mutations in the number and in the structure of the chromosomes. The main mechanisms of the spontaneous mutations. Mutagenic environmental factors: physical, chemical and biological agents. Role of the mutations in the evolution of the genes and their products. Oncogenes and antioncogenes: main features a mechanisms of activation.

Genes and DNA. The central dogma of genetics: replication, transcription and translation. The genetic code: definition and properties. Historical evolution of the functional definition of the gene. The prokaryotic and eukaryotic genes. The evolution of eukaryotic genes. The genes in multiple copies and gene families. The ortholog and paralog genes. Pseudogenes. The regulation of gene expression; main models of regulation in prokaryotes and eukaryotes. Outline of developmental genes and differentiation.

Basic Methods for DNA analysis. Preparation of genomic DNA, PCR, enzymatic cut, electrophoresis, sequencing. The RFLP and their use in diagnostics.

- **Plant breeding**
  Inheritance and heritability of quantitative traits - genetic improvement and use of genetic variability - reproductive systems of cultivated plants - reproductive barriers: self-incompatibility, male sterility - relationship between reproductive system and method of genetic improvement - genetic structure of populations - traditional methods of genetic improvement in species reproducing by vegetative propagation, by autogamy and by allogamy - modern methods of plant genetic improvement - genetic engineering.

TEXTBOOK INFORMATION

- **Genetics**
  - **1. Binelli, Ghisotti e altri.** GENETICA. EdiSES, Napoli
  - **2. Russel PJ.** I-GENETICS: AMOLECULAR APPROACH. Benjamin-Cummings Pub Co Eds. **ISBN-10:** 0321772881. **ISBN-13:** 978-0321772886
  - **3. Griffiths et al**. INTRODUCTION TO GENETIC ANALYSIS. W H Freeman & Co Eds.; 11 edition.. **ISBN-10:** 1464109486. **ISBN-13:** 978-1464109485.

- **Plant breeding**
  1. **Miglioramento genetico delle piante agrarie**, Lorenzetti F., Albertini E., Frusciante L., Rosellini D., Russi L., Tuberosa L., Veronesi F. Edagricole

  2. **Genetica e genomica**, Barcaccia G. e Falcinelli M., Liguori editore. Volume II.

  3. **Genetica e genomica**, Barcaccia G. e Falcinelli M., Liguori editore. Volume III.

  4. **Biotecnologie sostenibili**, Galbiati M., Gentile A., La Malfa S., Tonelli C., Edagricole

  5. **Genetica Agraria-Genetica e biotecnologie applicate all'agricoltura**, F. Lorenzetti, S. Ceccarelli, D. Rossellini, F. Veronesi, Patron ed.

  6. **Breeding Field Crops,** Sleper DA, Poehlman JM, . Ames, Iowa, USA: Blackwell Publ., 2006.

  7. **Genetica**, Binelli G e Ghisotti D., Edises, 2018