UNIVERSITÀ DI PISA

GENETICS

CLAUDIO PUGLIESI

Anno accademico	2020/21
CdS	VITICULTURE AND ENOLOGY
Codice	191GG
CFU	6

Moduli	Settore/i	Tipo	Ore	Docente/i
GENETICA	AGR/07	LEZIONI	64	CLAUDIO PUGLIESI

Learning outcomes

Knowledge
Aim of the course is to provide students with a basic understanding of genetic mechanisms regulating the heredity of phenotypic traits and a basic knowledge of mutagenesis and quantitative trait analysis. The course intends also give information on real and potential applications of genetics, molecular biology and biotechnology on plant breeding with particular emphasis to grapevine.

Assessment criteria of knowledge
For the assessment of the knowledge ongoing written tests will be carried out, besides meetings between the teacher and the students by means of lessons aimed at evaluating the gained information. In particular:

- knowledge of the structure of nucleic acids, the formal genetics and population genetics;
- knowledge of the genetic mechanisms of plant reproduction;
- knowledge of the main spontaneous and induced mutations and the main methods of mutagenesis acts to broaden the genetic variability;
- knowledge of biotechnology in agriculture with particular reference to the vegetatively propagated plants like the grapevine.

Skills
At the end of the course:

- the student will not only appropriate skills and knowledge to the examination achievement, but the ability to update the continuous increase of its powers in the field of plant genetics;
- the student will have acquired the knowledge of the genetic mechanisms of inheritance based characters and how genetic variability, which allowed the evolution of every living thing was indispensable under domestication of cultivated plants as well as in breeding methods adopted today.

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Assessment criteria of skills
During the course assessment lessons will be carried out, during which the student must prove:

- have acquired the skills to perform formal genetics exercises;
- have acquired the ability to understand the main mechanisms of spontaneous and induced mutagenesis, the main classes of mutations; genetic transformation and quantitative genetics.

Behaviors
At the end of the course the student will acquire and/or develop:

- the ability to use the basic instruments and tools of a Genetics laboratory;
- the ability for extraction of nucleic acids (DNA and RNA) in different plant tissues;

the ability to address the issues related to induced mutations.

Assessment criteria of behaviors

The behaviour verification will be carried out:

- during numerical and/or laboratory practice exercises in which the degree of accuracy and precision of the activities will be evaluated;

during the assessment exercises aimed at evaluating the student's behaviour in response to the problems posed by the teacher.

Prerequisites

The Genetics course requires initial knowledges concerning:

- Organic Chemistry for what concerns organic molecule structure, main functional groups and chemical reactions;
- Botany for cell structure and plant development.

Teaching methods

- Lectures are held with the help of slides, whereas those in the laboratory are carried out in a teaching laboratory designed and equipped for Genetic practices exercises;
- the laboratory practice exercises are carried out in groups of students;
- it is provided the teaching material used in the lectures but also for communications of any kind with the students;
- the interaction between teacher and students takes also place through meetings, e-mail and counselling students;
- intermediate written test are present.

Syllabus

Aim of the course is to provide students with a basic understanding of genetic mechanisms regulating the heredity of phenotypic traits and a basic knowledge of mutagenesis and quantitative trait analysis. The course intends also give information on real and potential applications of genetics, molecular biology and biotechnology on plant breeding with particular emphasis to grapevine.
Complete Program

Organization and transmission of hereditary material.
Genome size. - The organization of hereditary material in prokaryotes and eukaryotes. - Chemical structure, number and morphology of chromosomes. - DNA replication and recombination. - Transcription RNA and RNA processing. - The genetic code and the translation of the genetic message. - Transmission of hereditary material in eukaryotes.
Regulation of gene expression and development in the Eukaryotes. - Mitosis, Meiosis and their consequences. Comparison between mitosis and meiosis.
Mendel's experiences. - Dominance. - Segregation. - Independent transmission. - The chromosomal bases of independent transmission. - Independent transmission and recombination. - Polyhybrids: general. - Self-fertilization and homozygosis. - Mendelian genetics and statistical analysis of data: chi square test.
Association, exchange and genetic maps. - The Bateson and Punnet experiment and the gene association. - Morgan experiments and demonstration of the localization of genes on chromosomes. - Recombination of associated genes. - Cross-over and genetic maps in diploid organisms. - Calculation of map distances through the two- and three-point test. Map functions. Interference. Physical distance ratio - genetic distance.
Multiple alleles. - General aspects. - Blood groups in humans. - Alleles of incompatibility in plants. The gene interactions. - General aspects. - Epistasy and complementary gene actions. - Penetrance and expressiveness.
Autogamy and allogamy. Cross and heterosis degeneration. – Male-sterility. - Systems of incompatibility in plants. - Characters related to sex.
Mutations. - Gene mutations. - Chromosomal mutations. - Genomic mutations (aplody, aneuploidy and polyploidy).
Transposable elements: main classes and characteristics.
Spontaneous and induced mutations. The main chemical and physical mutagens agents. - Use of mutations induced in the genetic improvement of cultivated plants with particular reference to vegetative propagation and grapevine species. - Chimeras.
The evolution of cultivated plants with particular reference to the grapevine.
Inheritance of quantitative characters. Genetic structure of plant populations cultivated with vegetative propagation, autogamous and allogames. The influence of environmental factors on quantitative characters: Johannsen's experiments. - Nilsson-Ehle's experiments with wheat. - East's experiments and the multifactorial hypothesis. - Genetic variability. Breakdown of genetic variability. - Selection and selection response. - Overview of the genetic improvement of grapevine.
Fundamentals of genetic engineering. - DNA amplification. - The polymerase chain reaction. - Cloning of genes. - Applications of recombinant DNA technologies. - Overview of in vitro cultures. Genetic variability induced by in vitro cultures. - Creation of transgenic plants.

Bibliography

1. D'Amato, S. Baroncelli, M. Durante- ***Genetica Vegetale*** – Bollati Boringhieri Editore.

1. Russell - ***Genetica*** – Edises, Napoli.

1. Falcinelli, G. Barcaccia – ***Genetica e Genomica*** 1°, 2° e 3°Vol. – Liguori Editore.

Non-attending students info

Not-attending students can follow the lessons using the teaching material provided by the teacher before the beginning of the lectures, and consulting the lesson log.

Assessment methods

- The examination consists of two or three ongoing oral tests, or a single final oral exam.
- the oral tests consist of a series of questions/exercises/problems concerning the topics covered in the course till one week before the examination. The positive ongoing tests are valid for the whole academic year;
- the oral test is passed if a mark of 18/30 is reached. If the student has a positive mark (at least 18/30) in both tests, the examination is considered passed and an average mark is calculated. In case the mark is below 18/30 in one or both tests, the student must take an examination on the part of the programme considered insufficient;
- The students who have to recover insufficient oral test(s) must take anorher oral examination on the program of the deficient test. For the students who want to improve the mark coming from the ongoing tests, the interview will concern the whole program;
- the oral examination is passed when the candidate is able to speak clearly and to use a correct terminology, when understand the main Genetics issues and is able to relate each other different parts of the program.

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