SCUOLA DI SCIENZE AGRARIE, FORESTALI, ALIMENTARI ED AMBIENTALI

ACADEMIC YEAR: 2016-2017	
COURSE: Plant Genetics	
TYPE OF EDUCATIONAL ACTIVITY: Basic	
TEACHER: Giovanni Figliuolo	
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Language: Italian	

ECTS 6 CFU (4 of lessons, 1 of tutorials, 0.2 laboratory/practice and 0.8 Others)	n. of hours: 60 (40 of lessons, 10 of tutorials, 2 of practice, 2 others)	Campus: Potenza School: SAFE Program: Forest and Environmental Sciences	Semester: II

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

General goals: genetic relatedness among related individuals as well as the basics of transmission genetics within the framework of forestry population genetics will be learned by students. In addition, students will learn how to improve environmental adaptation of natural/native forests and how to generate propagation cultivars by applying the plant breeding cycle.

Specific goals:

- The experimental method used to discover Mendel's principles of heredity.
- The genetic control of the phenotypic trait expression and the environmental effect.
- Structure and function of the genetic molecular material (Dna and Rna): from gene to phenotype. Chromosomes, cell cycle, sex and meyosis. From where rare genotypes are coming?
- Species vs population(s): is an individual, one population or the species the same thing?
- Speciation, and processes regulating species fitness.
- Business perspectives associated to plant breeding, and management tools to protect forest biodiversity in natural or quasi-natural sites.

Learning outcomes: by acquiring the 6 credits of Plant Genetics, students will be able to understand the genetic variation within and between family, within and between populations and among different species. In addition students will be able to design basic schemes of artificial selection for breeding purposes as well as basic projects designed to forest plant genetic conservation by using strong genetic indicators.

PRE-REQUIREMENTS

- Higher school basic knowledges in the field of Biology and Natural science

SYLLABUS

General: genetic basis of inheritance, structure, relevance of forest tree genetic variation, and methods to improve:

c) Environmental adaptation of native populations, and

d) yield performance of tree cultivation.

Specific: 1° section: 3 credits

- The experimental method and the Chi-square test.
- Mendel's experiments: the principles of independent segregation and assortment.
- The "magic number" of Mendelian's Genetics and probability rules.
- Dominance (complete and incomplete), co-dominance, lethal, semi-lethal and deleterious alleles, multiple

alleles (genetic incompatibilities within populations: sporophytic, gametophytic incompatibilities and blood groups in mammals) pleiotropy, penetrance, expressivity and epistasis.

- Relationships between genotype and phenotype in qualitative and quantitative traits. Definition of "quantity", statistics of quantitative traits (frequency, average, variance, standard deviation), the importance of phenotypic variance in genetic analysis.
- Chromosomes, genes and gene-linkage: sexuality, cell cycle, meyosis, chromosome morphology and structure, relationships between genes, chromosomes and phenotypic traits.
- Molecular genetics: the genetic material (Dna and Rna), Dna replication, the eukaryote gene structure, gene expression, Dna replication, genetic code, point mutations.

2° section: 3 credits

- Population genetics: population, species, lower-order taxonomic units; genetic polymorphism, genetic equilibrium, evolutionary factors and speciation models; heterozygosity vs inbreeding and, diversity index.
- Plant breeding: specific traits/constraints halting the progress of the breeding of long-living plant species; cycle of plant breeding; heritability of quantitative traits. Artificial selection: base population and provenance; racial/ecotype selection; intra-ecotype selection; mass selection, family selection; individuals within family selection; genetic selection of plant material applying the pedigree method. The use of genomic mutations (auto and allo-polyploidy) and, generation of inter-specific hybrids.
- Biodiversity conservation: in situ genetic-conservation; analysis of the spatial distribution of genetic variation; indicators to be used in conservation genetics (effective population size vs. real and expected heterozygosity).

Short history of forest genetics: Relevant Scientists, Institutions and breeding goals in the last two centuries.

TEACHING METHODS

Lecturing: lectures are delivered into the classroom. Verbal communication is associated to the use of written outlines and logical frameworks on the classroom main board. Communication will consider voice volume, facial expression, gestures and eye-contact; lecture organization is explicit; often anecdotes and stories are included into the lecture to grab student attention; budget time is reserved for questions; knowledge source: see tools for teaching. Multi-media methods (internet connections, videos, etc.) are suggested as home-work practice in order to consolidate the topic knowledges of Plant Genetics syllabus. For a discipline like Plant Genetics, which is mainly formal in its content (Mendelian genetics, population genetics and breeding), and descriptive just for molecular genetics, the proposed type of knowledge delivering will allow the correct parallelism between the "time required for teaching" and student's "time necessary to listen and take notes". Usually, before each lecture main topics from the previous lecture are summarized.

Putting theory into practice: ten hours will be dedicated to put into practice theoretical knowledge. Exercises, tests and logical frameworks will be elaborated in classroom by students with the teacher assistance. Students learning will be monitored trough informal colloquiums during the interval between first and second hour of lecture.

Field trips: in situ walking will allow to practice "biodiversity analysis" from landscape scale to site-specific habitat-level. Interspecific hybrids (within the genus Populus or Quercus) will be identified. Phenotypic variation within half-sib sisters and within species population will be highlighted, as well as the role of seed and pollen migration will be assessed scanning the ecotonal belt of the site. For one forest species will be estimated the "Effective Number of Individuals" (Ne) in order to suggest (if necessary) best practices.

Laboratory: Two hours will be spent in the Genome Analysis Lab of M. Romana to understand how it works technology making Dna analysis. In particular it will be shown the Sanger method to sequence Dna and the generation of microsatellite markers.

Final exam: is mandatory and required by the Law. Following exam reservation each student has the right to be scored at the scheduled time..

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EVALUATION METHODS

The Plant Genetics exam will assess the degree of achievements of the expected learned outcomes. The exam is composed of two main sections: the first is based on the resolution of three exercises extracted from the text-book end-chapters; the oral examination will follow only if the written text is achieved with success. During the oral colloquium students can show how deep and wide is their knowledge. It is positively scored the ability to connect and integrate specific topics of the program into the perspective delineated by the general goal of the discipline.

Knowledge and Skills Required

Communication skill based on the use of appropriate terms and concepts, either in the written test or in the colloquium, are considered prerequisites for a successful exam. Also it is positively scored student's aptitude, based on sound scientific knowledge, to infer empirical generalizations from theoretical propositions.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Textbooks

- Genetica Vegetale. G. Figliuolo. (2014). Ed. Favia, Modugno (Ba) – (mandatory)

or:

- Genetica Moderna. Ayala F.J., Kiger J.J. Ed. Zanichelli (available at Biblioteca Interdipartimentale) (I part of the course: 3 ECTS)
- Forest Genetics. W. T. Adams, D. B. Neale - CABI Publishing (available at Biblioteca Interdipartimentale) (II part of the course: 3 ECTS)

INTERACTION WITH STUDENTS

Direct interaction during teaching and academic assistance either in M. Romana (Potenza) or in S. Rocco (Matera); indirect communication using internet and phone.

EXAMINATION SESSIONS (FORECAST)[1]

The second Wednesday of each month but August.

EVALUATION BOARD

Prof. Giovanni FIGLIUOLO
Prof. Giuseppe, MARTELLI
Dott. Giuseppina LOGOZZO

SEMINARS BY EXTERNAL EXPERTS YES □ NO X

FURTHER INFORMATION

Realistic examination schedules will appear on the Esse - electronic register at the end of the course.

[1] Subject to possible changes: check the web site of the Teacher or the Department/School for updates.