

# **Horticultural Genetics and Biotechnology**

Organized by

Mediterranean Agronomic Institute of Chania

# Horticultural Genetics and Biotechnology

MAI coordinator: Dr. Panagiotis KALAITZIS

**Aims:** The major aim of the Horticultural Genetics & Biotechnology programme is to provide the students with a thorough grounding in the mechanisms, capabilities, uses and limitations of plant biotechnological methods and available technological platforms so that they will be able to apply them to problems related to horticultural production and product quality. MSc graduates can follow an academic career in biotechnology, genetics and/or molecular biology as well as a career in agrobusinesses private sector and agricultural governmental bodies.

**Objectives:** The students shall:

- a) acquire specific technical skills in plant biotechnology and genetics;
- b) develop conceptual knowledge and critical thinking, hypothesis design and testing on plant biological and physiological themes pertinent to horticultural research;
- c) communicate clearly research outputs, and the rationale and knowledge underpinning these outputs;
- d) demonstrate understanding of advantages and limitations of –omics (genomics, metabolomics,) technological platforms and how are used for problem solving approaches;
- e) ability to source information;
- f) efficient use of knowledge acquired from model plants such as Arabidopsis in order to formulate research approaches for their horticultural crops of interest.

# Part 1

## Post graduate specialization programme

The programme is organized in 6 Units (60 ECTS)

### Unit I STATISTICS (3 ECTS)

04 – 15 October, 2010

**Content:**  
Statistics.

**Learning outcomes:**

Students will be able to use advanced statistical software packages, and update their knowledge in statistical analysis.

### Unit II INTRODUCTION TO ADVANCED BIOLOGY (18 ECTS)

18 – 31 December 2010

**Content:**  
Biochemistry.  
Cell Biology.  
Genetics.  
Molecular Biology.  
Molecular Biology Techniques (Laboratory).  
Stress Physiology.

**Learning outcomes:**

- a) knowledge of biological organization; b) understanding of how genetics and biology explain fundamental mechanisms of life in a cell;
- c) familiarity with key plant molecular biology techniques

### Unit III APPLIED GENETICS (9 ECTS)

03 January - 04 February  
2011

**Content:**  
Molecular Breeding of Horticultural Crops.  
Genetic Association Studies.  
DNA Fingerprinting Technology.

**Learning outcomes:**

- a) Molecular markers combined with genetic diversity assessment can be used to assist breeding approaches for crop improvement;
- b) Use of molecular markers for QTL analysis.

### Unit IV ARABIDOPSIS GENETICS (9 ECTS)

07 February – 11 March  
2011

**Content:**  
Principles of Arabidopsis Genetics.  
Mutant Analysis of Arabidopsis.  
Arabidopsis Transformation and Analysis of Transgenic Plants.

**Learning outcomes:**

- a) how complex biological questions (hormonal regulation) can be dissected using the Arabidopsis genetic tools;
- b) merging of Arabidopsis genetics and breeding.

## Unit V

## POST HARVEST BIOTECHNOLOGY (9 ECTS)

14 March – 06 May 2011

### **Content:**

Biotechnology of the Plant Hormone Ethylene.  
Molecular Biology of Fruit Ripening.  
CA Storage and Molecular Basis of Hypoxia.  
Nutritional Genomics.

### **Learning outcomes:**

- acquisition of the particular disciplines of biochemistry, physiology and molecular biology pertinent to quality of horticultural products;
- integration of metabolic pathways, metabolites, gene expression and enzymatic activities in order to explain developmental changes and programmes such as ripening and senescence of horticultural crops;
- manipulation of developmental programmes to consumers and producers benefits; d) ability to 'think across' levels (molecular, cellular, tissues, organs).

## Unit VI

## ADVANCED BIOTECHNOLOGICAL (-OMICS) PLATFORMS (12 ECTS)

09 May – 17 June 2011

### **Content:**

In-vitro Technologies for Applied Biotechnologies.  
Advanced GMO Detection Technologies.  
Introduction to Bioinformatics & Systems Biology (Metabolomics).  
Micro-array Analysis.

### **Learning outcomes:**

- totipotency of plant cells and their exploitation;
- critical appraisal of available –omics technological platforms and how can be integrated for the development of methodologies pertinent to food forensics, and GMO detection;
- formulation of judgements on how each platform can be used for problem solving approaches.

20-24 June 2011

## RETAKE EXAMS

27-30 June 2011

## ORAL EXAMS

## EXAMINATIONS

Participants are obliged to take an examination in order to obtain **an individual grade for each component** in the following arrangement: For every one or two week(s) of course delivery the given examination period is one week. For every three weeks of course delivery the given examination period is two weeks.

All units are subject to examination.

Examinations may take the form of written exams (problems, set of questions, exercises, multiple choice questions), individual or team work project, computer assisted exams or any combination of the above forms.

Retake examination is allowed for a maximum of three weeks course delivery (**9 ECTS**) of any unit **except the last four weeks** of course delivery (**12 ECTS**) of the final unit.

At the end of the 60 ECTS first year programme participants are obliged to take an oral comprehensive examination **weighting 15%** of the overall graduation grade.

*Language of instruction: ENGLISH*

## **ACADEMIC STAFF**

The academic visiting faculty of the Horticultural Genetics and Biotechnology programme is compounded by highly qualified professors from internationally renowned universities who are considered leaders in their fields. The scientific faculty of MAICh selects and invites them on the basis of specialisation to the subject matter, their international reputation and experience in teaching and research, as recognised by the academic community. MAICh is committed to the constant reviewing of the visiting faculty by the students on a yearly basis, in order to ensure the high quality of the teaching program and a dynamic adaptation to new scientific developments.

Additionally, the academic visiting faculty collaborates in the formulation of research and development projects, exchange of ideas and expertise for recent advances in science and encouragement for active participation in student's MSc thesis research projects through consultation and/ or assignment of official supervising duties. Outstanding MSc MAICh graduates are subsequently recruited into their reputable PhD programs on a full scholarship basis. A considerable number of former MAICh graduates are now active and successful members of the international academic community.

The following academic quality indicators have been achieved, during the period 1985-2005.

### **Research Indicators**

- **39%** of the total number of research Master theses have been published in peer review journals (256 publications);
- **43%** have been presented and published in international conferences and proceedings.

### **Academic Mobility Indicators**

- **28%** of graduates have been accepted with full scholarships in PhD programmes by highly ranked universities;
- **30** graduates and PhD holders serve as University Professors in their home country or abroad.

PROGRAM HORTICULTURAL GENETICS AND BIOTECHNOLOGY					
Academic Year 2010-2011					
Weeks	TITLE	INSTRUCTORS	WEIGHT	%	DATES
	<b>Unit I: HOB 510 Statistics - 3 ECTS</b>				<b>04/10-15/10/2010</b>
1	HOB 510.1 STATISTICS	A. Mavroustakos		100	04-08/10/2010
2	<b>EXAMS</b>				11-15/10/2010
	<b>Unit II : HOB 520 Introduction to Advanced Biology</b>		<b>18</b>		<b>18/12-31/12/2010</b>
3	HOB 520.1 BIOCHEMISTRY	P. Spilianakis	3	16	18-22/10/2010
4	HOB 520.2 CELL BIOLOGY	A. Bozabalidis	3	16	25-29/10/2010
5	HOB 520.3 GENETICS	A. Tsafaris	3	17	01-05/11/2010
6	<b>EXAMS</b>		3	17	08-12/11/2010
7	<b>EXAMS</b>				15-19/11/2010
8	HOB 520.4 MOLECULAR BIOLOGY	Chr. Panagiotidis	3	17	22-26/11/2010
9	HOB 520.5 MOLECULAR BIOLOGY TECHNOLOGIES (LAB)	P. Kalaitzis	3	17	29/11-03/12/2010
10	HOB520.6 STRESS PHYSIOLOGY	T. Awada	3	17	06-10/12/2010
11	<b>EXAMS</b>				13-17/12/2010
12	<b>EXAMPREPARATION</b>				<b>20-24/12/2010</b>
13	<b>EXAMPREPARATION</b>				<b>27 - 31/12/2010</b>
	<b>Unit III: HOB 530 Applied Genetics - 9 ECTS</b>				<b>03/01-04/02/2011</b>
14	HOB 530.1 MOLECULAR BREEDING OF HORTICULTURAL CROPS	G. Skarakis	3	34	03-07/01/2011
15	HOB 530.2 GENETIC ASSOCIATION STUDIES and QTL ANALYSIS	M. Morforte	3	33	10-14/01/2011
16	HOB 530.3 DNA FINGERPRINTING TECHNOLOGY	P. Kasapidis / E. Sarropoulou	3	33	17-21/01/2011
17	<b>EXAMS</b>				24-28/01/2011
18	<b>EXAMS</b>				31/01-04/02/2011
	<b>Unit IV: HOB 540 Arabidopsis Genetics - 9 ECTS</b>				<b>07/02-11/03/2011</b>
19	HOB 540.1 PRINCIPLES OF ARABIDOPSIS GENETICS	K. Vlachonasios	3	34	07-11/02/2011
20	HOB 540.2 MUTANT ANALYSIS OF ARABIDOPSIS	E. Benkova / J. Friml	3	33	14-18/02/2011
21	HOB 540.3 ARABIDOPSIS TRANSFORMATION AND ANALYSIS OF TRANSGENIC PLANTS	P. Hatzopoulos	3	33	21-25/02/2011
22	<b>EXAMS</b>				28/02-04/03/2011
23	<b>EXAMS</b>				07-11/03/2011
	<b>Unit V : HOB 550 Post-Harvest Biotechnology - 12 ECTS</b>				<b>14/03-06/05/2011</b>
24	HOB 550.1 BIOTECHNOLOGY OF THE PLANT HORMONE ETHYLENE	J. Pech	3	25	14-18/03/2011
25	HOB 550.2 MOLECULAR BIOLOGY AND FRUIT RIPENING	P. Tonutti	3	25	21-25/03/2011
26	<b>EXAMS</b>				28/03-01/04/2011
27	HOB 550.3 CA STORAGE AND MOLECULAR BASIS OF HYPOXIA	P. Kalaitzis	3	25	04-08/04/2011
28	HOB 550.4 NUTRITIONAL GENOMICS	A. Kanellis	3	25	11-15/04/2011
29	<b>EXAMPREPARATION</b>				18-22/04/2011
30	<b>EXAMPREPARATION</b>				25-29/04/2011
31	<b>EXAMS</b>				02-06/05/2011
	<b>Unit VI: HOB 560 Advanced Biotechnological (-Omics) Platforms) 12 ECTS</b>				<b>09/05 - 17/06/2011</b>
32	HOB 560.1 IN-VITRO TECHNOLOGIES FOR APPLIED BIOTECHNOLOGIES	E. Rugini	3	25	09-13/05/2011
33	HOB 560.2 ADVANCED GMO DETECTION TECHNOLOGIES (LAB)	Th. Christopoulos	3	25	16-20/05/2011
34	HOB 560.3 INTRODUCTION TO BIOINFORMATICS AND SYSTEMS BIOLOGY	M. Klapa	3	25	23-27/05/2011
35	HOB 560.4 MICRO-ARRAY ANALYSIS	M. Vuysteke	3	25	30/05-03/06/2011
36	<b>EXAMS</b>				06-10/06/2011
37	<b>EXAMS</b>				13-17/06/2010
38	<b>RETAKE EXAMS</b>				<b>20-24/06/2011</b>
39	<b>ORALS</b>				<b>27-30/06/2011</b>

HORTICULTURAL GENETICS AND BIOTECHNOLOGY PROGRAM - Academic year 2010-2011

## Part 2

### The Master of science programme

#### Project (9 months duration, 60 ECTS)

All the students develop the ability to hypothesis design and testing through experimentation, to clearly communicate research outputs and ideas and to write scientific English. In addition, they become competent in a wide range of plant molecular biology and biotechnology techniques such as plant nucleic acid extractions, gene expression analysis, basic bioinformatics tools and cloning techniques, basic genetic concepts for mutants and transgenic plants analysis.

#### Research activities: topics generally available for Master of Science theses

- Arabidopsis genetics and hormonal regulation (ethylene);
- Role of prolyl 4 hydroxylases in plant growth and development;
- Regulation of fruit ripening and Arabinogalactans;
- Agrofood forensics and development of biotechnological methodologies for authenticity of olive and olive products and food products that cause allergies such as sesame;
- Genetic diversity assessment of horticultural crops.

#### INDICATIVE MASTER THESES REALIZED WITHIN THE AREA

1. **Title:** Molecular and Biometrical Methods to Study Inheritance of Seed Size, Shape and Quality in Hazelnut (*Corylus Avellana* L.)  
**Author:** Ljiljana Kuzmanovic  
**Place of Realization:** Viterbo University, Italy  
**Thesis director:** E. Rugini
2. **Title:** Development of DNA-based Methodologies for the Authenticity of Food Commodities of Plant Origin  
**Author:** Claire El Zoghby  
**Place of Realization:** Horticultural Genetics & Biotechnology Laboratory, MAICH  
**Thesis director:** P. Kalaitzis
3. **Title:** Involvement of the Arabinogalactan Proteins in the Anoxic and Hypoxic Response of Mature Green Tomatoes  
**Author:** Faten Dandachi  
**Place of Realization:** Horticultural Genetics & Biotechnology Laboratory, MAICH  
**Thesis director:** P. Kalaitzis
4. **Title:** Involvement of the Arabidopsis prolyl 4 hydroxylase 9 gene in salt stress  
**Author:** Omar Heliel  
**Place of Realization:** Horticultural Genetics & Biotechnology Laboratory, MAICH  
**Thesis director:** P. Kalaitzis
5. **Title:** A Study on the Molecular Basis of Alterations in Ethylene Production in Prolyl 4 Hydroxylase 9 T-DNA Knockout Mutant  
**Author:** Amel Yamoune  
**Place of Realization:** Horticultural Genetics & Biotechnology Laboratory, MAICH  
**Thesis director:** P. Kalaitzis
6. **Title:** Characterization of Prolyl 4 Hydroxylases Genes Utilizing in Silico and in Vitro Approaches  
**Author:** Issam Rabi  
**Place of Realization:** Horticultural Genetics & Biotechnology Laboratory, MAICH  
**Thesis director:** P. Poirazi

**Detailed additional information (ECTS guide) and in particular an analytical syllabus is available at [www.maich.gr/hort/](http://www.maich.gr/hort/)**