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 agrobussinesses private sector and agricultural governamental 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
05 Oct. to 16 October '09

STATISTICS (3 ECTS)

Content:
Statistics.

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

Unit II
19 Oct. to 04 January'10

INTRODUCTION TO ADVANCED BIOLOGY (18 ECTS)

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
05 Jan. to 05 February'10

APPLIED GENETICS (9 ECTS)

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
08 Feb. to 12 March'10

ARABIDOPSIS GENETICS (9 ECTS)

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)**

15 March. to 30 April'10

Content:

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

Learning outcomes:

a) acquisition of the particular disciplines of biochemistry, physiology and molecular biology pertinent to quality of horticultural products;
b) 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;
c) 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)**

03 May to 11 June'10

Content:

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

Learning outcomes:

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

14 to 18 June/10 **RETAKE EXAMS**

21 to 25 June'10 **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.

Weeks	TITLE	CREDITS	DATES
	Unit I Statistics	**3**	**05/10-16/10/2009**
1	Component 1- STATISTICS		05-09/10/2009
2	**EXAMS**		12-16/10/2009
	Unit II Introduction to Advanced Biology	**18**	**19/10/2008-04/01/2010**
3	Component 1 - BIOCHEMISTRY		19-23/10/2009
4	Component 2 - CELL BIOLOGY		26-30/10/2009
5	**EXAMS**		02-06/11/2009
6	Component 3 - GENETICS		09-13/11/2009
7	Component 4 - MOLECULAR BIOLOGY		16-20/11/2009
8	Component 5 - MOLECULAR BIOLOGY TECHNOLOGIES (LAB)		23-27/11/2009
9	**EXAMS**		30/11-04/12/2009
10	**EXAMS**		07-11/12/2009
11	Component 6 - STRESS PHYSIOLOGY		14-18/12/2009
12	***EXAM PREPARATION***		***21-25/12/2009***
13	***EXAM PREPARATION / 04-01-2010 EXAM***		***28/12/2009-01/01/2010***
	Unit III Applied Genetics	**9**	**05/01-05/02/2010**
14	Component 1 - MOLECULAR BREEDING OF HORTI-CULTURAL CROPS		05-09/01/2010
15	**EXAMS**		11-15/01/2010
16	Component 2 - GENETIC ASSOCIATION STUDIES		18-22/01/2010
17	Component 3 - DNA FINGERPRINTING TECHNOLOGY		25-29/01/2010
18	**EXAMS**		01-05/02/2010
	UNIT IV Arabidopsis Genetics	**9**	**08/02-12/03/2010**
19	Component 1 - PRINCIPLES OF ARABIDOPSIS GENET-ICS		08-12/02/2010
20	Component 2 - MUTANT ANALYSIS OF ARABIDOPSIS		15-19/02/2010
21	Component 3 - ARABIDOPSIS TRANSFORMATION AND ANALYSIS OF TRANSGENIC PLANTS		22-26/02/2010
22	**EXAMS**		01-05/03/2010
23	**EXAMS**		08-12/03/2010
	Unit V Post-Harvest Biotechnology	**9**	**15/03-30/04/2010**
24	Component 1- BIOTECHNOLOGY OF THE PL.ANT HORMONE ETHYLENE		15-19/03/2010
25	Component 2 - MOLECULAR BIOLOGY AND FRUIT RIPENING		22-26/03/2010
26	***EXAM PREPARATION***		***29/03-02/04/2010***
27	***EXAM PREPARATION***		***05-09/04/2010***
28	AUDIT - CA STORAGE AND MOLECULAR BASIS OF HYPOXIA		12-16/04/2010
29	Component 3 - NUTRITIONAL GENOMICS		19-23/04/2010
30	**EXAMS**		26-30/04/2010
	Unit VI Advanced Biotechnological (-Omics) Platforms	**12**	***03/05-11/06/2010***
31	Component 1- IN-VITRO TECHNOLOGIES FOR APPLIED BIOTECHNLOGIES		03-07/05/2010
32	Component 2 - ADVANCED GMO DETECTION TECHNOLOGIES (LAB)		10-14/05/2010
33	Component 3 – INTRO TO BIOINFORMATICS & SYSTEMS BIOLOGY		17-21/05/2010
34	Component 4 - MICRO-ARRAY ANALYSIS		24-28/05/2010
35	**EXAMS**		31/05-04/06/2010
36	**EXAMS**		07-11/06/2010
37	**RETAKE EXAMS**		14-18/06/2010
38	**ORAL EXAMS**		**21-25/06/2010**

Part 2
The Master of Science Thesis

Project (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**: Role of the SI-IAA Transcription Factor in Fruit Quality Using Reverse Genetics in Tomato
   Author: Barsan, Christina, Biotechnologist, Romania (2006)
   Place of Realization: INP Ensat, France
   Thesis Director: J. Pech

2. **Title**: DNA Based Technologies for the Authentication of Olive Oil
   Author: Bazakos, Christos, Agronomist, Greece (2007)
   Place of Realization: Hort Gen & Biotech Laboratory, MAICh
   Thesis Director: P. Kalaitzis

3. **Title**: Molecular and Biometrical Methods to Study Inheritance of Seed Size, Shape and Quality in Hazelnut (*Corylus Avellana* L.)
   Author: Kuzmanovic, Ljiljana, Agriculturist, Serbia (2007)
   Place of Realization: Viterbo University, Italy
   Thesis Director: E. Rugini

4. **Title**: Characterization of Arabidopsis *p4h9* T-DNA knock out mutant
   Author: Rishmawi, Louai, Agronomist, Palestine
   Place of Realization: Hort Gen & Biotech Laboratory, MAICh
   Thesis Director: P. Kalaitzis, K. Vlachonasios

5. **Title**: Study on the effect of 2,4 pyridine-dicarboxylate on hormonal regulation of senescence in cut carnation flowers
   Author: Oualid, Fatiha, Agronomist, Algeria
   Place of Realization: Hort Gen & Biotech Laboratory, MAICh
   Thesis Director: P. Kalaitzis

Detailed additional information is available at http://www.maich.gr/hort/