

## 5.1 Explicación del Plan de Estudios

El plan de estudios del Máster Europeo en Sanidad Vegetal en Agricultura Sostenible / European Master degree in Plant Health in Sustainable Cropping Systems que se imparte en la Universidad Politécnica de Valencia se desarrolla durante dos cursos con una carga total de 120 ECTS.

El programa consta de un primer año primer como en el segundo semestre (60 ECTS), los estudiantes estudiarán asignaturas relacionadas con aspectos básicos de la producción vegetal, estadística, sanidad vegetal, técnicas moleculares aplicadas a la sanidad vegetal, fisiología vegetal y ecología.

| <b>Primer semestre<br/>Octubre-Enero</b>   | <b>Segundo semestre<br/>Febrero-Junio</b>                                   |
|--|---|
| 1-Sistemas de cultivo sostenibles<br>4,5 ECTS                                    | 8-Malherbología<br>4,5 ECTS   |
| 2-Botánica agrícola<br>4,5 ECTS  | 9-Entomología aplicada<br>6 ECTS  |
| 3-Toma de datos, análisis y métodos científicos en ciencias de la vida<br>6 ECTS | 10-Patología Vegetal<br>6 ECTS  |
| 4-Conservación de la biodiversidad<br>4,5 ECTS                                   | 11-Respuesta fisiológica de las plantas a plagas y enfermedades<br>4,5 ECTS |
| 5-Adaptación al cambio climático en agroecosistemas<br>4,5 ECTS                  | 12-Técnicas moleculares en protección de cultivos<br>3 ECTS                 |
| 6-Genética de poblaciones<br>3 ECTS  | 13-Trabajo práctico<br>6 ECTS   |
| 7-Idiomas<br>3 ECTS  |   |

En el primer semestre del segundo año (30 ECTS), estudiarán asignaturas específicas sobre la aplicación de sistemas de Gestión Integrada de plagas, enfermedades y malas hierbas en cultivos mediterráneos.

El último semestre se dedicará a la Tesina de Máster (30 ECTS). La Tesis de Máster es un elemento clave del programa PlantHealth, para proporcionar a los estudiantes conocimientos científicos aplicados en el ámbito de la Sanidad Vegetal y contribuir al desarrollo de habilidades en la búsqueda de bibliografía y documentación de gestión, realización de presentaciones orales, escritura científica, etc.

| <b>Tercer semestre<br/>Octubre-Enero</b>                              | <b>Cuarto semestre<br/>Febrero-Junio</b> |
|---|--|
| 1-Identificación y monitoreo de plagas y enemigos naturales<br>3 ECTS | <b>Tesina de Máster</b><br>30 ECTS       |
| 2-Epidemiología de enfermedades<br>3 ECTS                             |  |
| 3-Control biológico de plagas, enfermedades y malas hierbas<br>3 ECTS |  |
| 4-Productos fitosanitarios y otras medidas de control<br>3 ECTS       |  |

|  |  |
|--|--|
| 5-GIP en cultivos hortícolas y ornamentales<br>mediterráneos<br>6 ECTS     |  |
| 6-GIP en frutales mediterráneos<br>6 ECTS                                  |  |
| 7-GIP en la práctica: implementación,<br>desarrollo y evaluación<br>3 ECTS |  |
| 8-Idiomas<br>3 ECTS  |  |

# ► COURSE CONTENTS

## M1 COURSES

### Polytechnic University of Valencia SCHEDULE of the M1 program

| 1 <sup>st</sup> semester (winter)<br>October - February                            | 2 <sup>nd</sup> semester (summer)<br>April - July                          |
|--|--|
| 1 Sustainable farming systems<br>4,5 ECTS  | 8 Weed Biology<br>4,5 ECTS   |
| 2 Agricultural Botany<br>4,5 ECTS  | 9 Applied Entomology<br>6 ECTS   |
| 3 Data acquisition, analyses, and scientific methods<br>in life sciences<br>6 ECTS | 10 Plant Pathology<br>6 ECTS   |
| 4 Biodiversity Conservation<br>4,5 ECTS  | 11 Physiological responses of plants to pathogens<br>and pests<br>4,5 ECTS |
| 5 Adaptation to climate change in agroecosystems<br>4,5 ECTS                       | 12 Molecular Techniques in Plant Protection<br>3 ECTS                      |
| 6 Population Genetics<br>3 ECTS  | 13 Internship<br>6 ECTS  |
| 7 Languages<br>3 ECTS  |  |

#### Modules' description

#### **1 Sustainable farming systems**

**135 Hours 4,5 ECTS**

##### **Module objectives (knowledge /skills acquisition, learning outcomes):**

This module offers to the students the basis to understand the processes involved in agriculture in order to establish ecologically and economically sustainable models of agriculture. Students will acquire knowledge on plant-environment interactions; soil fertility and biology, and appropriate use of water in crop; rational use of agro-technical processes; integrated crop management and organic production; environmental impact of farm practices; beneficial management practices; and relationships between producers and consumers.

**Methodology:** Case studies, lectures, practical and personal work

#### **2 Agricultural Botany**

**135 Hours 4,5 ECTS**

##### **Module objectives (knowledge /skills acquisition, learning outcomes):**

The course provides knowledge on plants with agricultural interest, especially species of horticultural, pomicultural, ornamental, fodder, or industrial importance. Their main morphological characteristics, origin, distribution, utility, and ecology will be analyzed.

**Methodology:** lectures, laboratory practical classes, field trips

#### **3 Data acquisition, analyses, and scientific methods in life sciences**

**180 Hours 6 ECTS**

##### **Module objectives (knowledge /skills acquisition, learning outcomes):**

The main goal of the module is to understand the scientific method, and preparing the students to adopt an efficient methodology for their scientific work. Participants learn various data acquisition methods for different analysis methodologies used in life sciences. They will be trained in the use of a powerful tool for statistics in order to understand the statistics tools used in life sciences. Students learn how to design research projects in accordance with scientific methods.

**Methodology:** Lectures, tutorship, practical work, computer practices and personal work.

#### **4 Biodiversity Conservation**

**135 Hours 4,5 ECTS**

##### **Module objectives (knowledge /skills acquisition, learning outcomes):**

Conservation and use of biodiversity is a major issue in Mediterranean ecosystems and sustainable agriculture. Module objectives cover: assess natural biodiversity using its three components: alpha, beta and gamma; determine habitats present in a landscape, and evaluate them in terms of its succession stage; estimate the degree of threat, and rarity (endemism) of plant and animal species; and identify genetic resources. Students will learn on measuring agricultural sustainability and assessing environmental impact in agroecosystems.

**Methodology:** Lectures, case studies: data biodiversity analysis, multivariate statistical methods, laboratory and field work, and /or personal work.

### 5 Adaptation to climate change in agroecosystems

135 Hours 4,5 ECTS

**Module objectives (knowledge/skills acquisition, learning outcomes):**

This module will allow students to develop their understanding of the facts relevant to understanding climate change. Students will focus on the issues of climate change along history with a detailed consideration of global warming impacts, predictions and climate change adaptation strategies in plants, future mitigation options in areas of critical concern as well as environmental treaties.

**Methodology:** Lectures, practical works, case studies, personal work

### 6 Population Genetics

90 Hours 3 ECTS

**Module objectives (knowledge /skills acquisition, learning outcomes):**

The objective of this module is to present the principal concepts about the evolution of the biodiversity of populations with a genetic basis; and to provide analytical tools for estimate it, with some applications on conservation biology, management of populations and identification of pest and pathogens of plants. The students will gain a better understanding of what bioinformatics tools are available to them and how they could be incorporated into their projects or interests.

**Methodology:** Lectures, case studies, personal work

### 7 Languages

90 Hours 3 ECTS

**Module objectives (knowledge /skills acquisition, learning outcomes):**

Improvement of language competence, either language required for M1 or M2 local language.

**Methodology:** lectures and personal work.

### 8 Weed Biology

135 Hours 4,5 ECTS

**Module objectives (knowledge /skills acquisition, learning outcomes):**

The main objective of this module is to involve students into the most important weed management problems in Mediterranean crops (citrus, rice, vegetables,...). Students will study weed biology and control methods for both organic and conventional agriculture systems in order to really understand weed competition, crop production and environmental hazards of diverse control methods

**Methodology:** Lectures, laboratory and field work.

### 9 Applied Entomology

180 Hours 6 ECTS

**Module objectives (knowledge /skills acquisition, learning outcomes):**

Students learn about the main groups of insects and mites in agriculture, and to understand the basis of their morphology and biology. They will acquire knowledge on biodiversity, morphology and biology of the orders; biology and identification of selected families of insects, and systematics, morphology, physiology, and ecology of mites.

**Methodology:** case studies, lectures, practical and personal work

### 10 Plant Pathology

180 Hours 6 ECTS

**Module objectives (knowledge /skills acquisition, learning outcomes):**

Students learn the causal agents of diseases, the symptoms associated to them and how pathogens attack plants. They will acquire knowledge on biology, morphology and taxonomy of the main groups of plant pathogens (fungi, bacteria, phytoplasmas, viruses, and nematodes).

**Methodology:** case studies, lectures, practical and personal work.

### 11 Physiological responses of plants to pathogens and pests

135 Hours 4,5 ECTS

**Module objectives (knowledge /skills acquisition, learning outcomes):**

Students will study the bases of the absorption and transport of nutrients in plants and of plant growth and development and how these processes are controlled by environmental and endogenous factors. This preliminary knowledge will allow them to follow in depth subsequent studies on plant health. Students will learn about the ways in which the different plant pathogens cause disease and the diverse plant defense systems. R-gene mediated disease resistance, biochemistry of plant defense reactions and systemic plant defense responses will be covered.

**Methodology:** lectures, seminars and personal work

## 12 Molecular Techniques in Plant Protection

90 Hours 3 ECTS

### Module objectives (knowledge/skills acquisition, learning outcomes):

The main objective is to provide to the students the basic concepts of the molecular techniques used for diagnosis in Plant Pathology and molecular identification and/or characterization of pathogens, pests and weeds. The students will receive training on several techniques: ELISA (enzyme-linked immunosorbent assay), acid nucleic hybridization, Polymerase chain reaction (PCR), PCR-RFLP, sequencing, and Blast applied to molecular identification, and analysis of double strand RNAs

**Methodology:** lectures, laboratory and personal work

## 13 Internship

180 Hours 6 ECTS

### Module objectives (knowledge/skills acquisition, learning outcomes):

Specific knowledge of the respective area of work/research will be acquired, social abilities like work organization, teamwork, interdisciplinary work, flexibility will be practiced.

**Methodology:** practical work

## M2 COURSES

### Polytechnic University of Valencia SCHEDULE of the M2 program

| 3 <sup>rd</sup> semester (winter)<br>October - February                | 4 <sup>th</sup> semester (summer)<br>April - July |
|--|---|
| 1 Identification and monitoring of pests and beneficials<br>3 ECTS     | <b>Master thesis</b>                              |
| 2 Disease epidemiology<br>3 ECTS                                       |   |
| 3 Biological control of pests, pathogens and weeds<br>3 ECTS           |   |
| 4 Pesticides and other pest control measures<br>3 ECTS                 |   |
| 5 IPM in Mediterranean vegetables and ornamentals<br>6 ECTS            |   |
| 6 IPM in Mediterranean fruit crops<br>6 ECTS                           |   |
| 7 IPM in practice: implementation, assessment and evaluation<br>3 ECTS |   |
| 8 Languages<br>3 ECTS  |   |

#### Modules' description

#### 1 Identification and monitoring of pests and beneficials

**90 Hours 3 ECTS**

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Students have to know the identification basis for the main groups of arthropods, with emphasis in Mediterranean pests and their beneficial natural enemies. They have to learn basic concepts on population ecology and regulatory factors in population growth. Concepts on spatial distribution of arthropods will be a prerequisite to understand the importance to assess population densities, the main sampling methods in IPM and the importance of populational thresholds.

**Methodology:** lectures, cases of study, personal work, laboratory and field work

#### 2 Disease diagnostic and epidemiology

**90 Hours 3 ECTS**

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Students have to learn how to diagnose and identify the main groups of pathogens using classical, electron microscopy (scanning and transmission), serological and molecular methods. They will learn the incidence of pathogens in Mediterranean countries, including the different types of inoculum and inoculum dispersal. Students will gain experience in disease forecast and epidemiological models in Mediterranean crops.

**Methodology:** lectures, cases of study, personal work, laboratory and field work

#### 3 Biological control of pests, diseases and weeds

**90 Hours 3 ECTS**

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Objectives will include the general framework of biological pest control and the comparison between biological, chemical and IPM methods. The students have to recognize the major groups of natural enemies used in biological pest control, predators, parasitoids and pathogens, their biology, behaviour and practical application. They have to understand the main techniques: classical biological control by importation, rearing and mass release and conservation of natural enemies. They will also learn about biological control of plant pathogens and weeds, how to conserve epiphytic microorganisms on fruits and vegetables for biological control.

**Methodology:** Lectures, cases of study, personal work, laboratory and field work

#### 4 Pesticides and other pest control measures

**90 Hours 3 ECTS**

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Students have to know the main groups of insecticides, acaricides, fungicides and herbicides and their mode of action. They have to understand the economic and environmental aspects of pesticide use. They have to know the basic concepts of pest resistance and the strategies of resistance management. They will know the basis of experimental design and analysis in pesticide field trials and laboratory bioassays. Students will also learn the

importance of quarantine and certification and regulation in IPM programs. They will acquire knowledge in other control methods, such as cultural pest control, plant resistance and mechanical and physical control.

**Methodology:** Lectures, cases of study, personal work, laboratory and field work.

#### 5 IPM in Mediterranean vegetables and ornamentals

180 Hours 6 ECTS

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Students have to gain enough knowledge in biology and ecology of the major injurious and beneficial arthropods inhabiting vegetables and ornamental crops in the Mediterranean. They have to recognize the typical symptoms of their feeding activity. The monitoring techniques used to assessing populational densities and the criteria to select the adequate pest management method will be also a prime objective. They will also study the main fungi, bacteria, viruses, virus-like agents and nematodes affecting Mediterranean vegetables and ornamentals, and the symptoms they cause. They will acquire experience about the main weeds on vegetables and ornamentals. They also have to understand the factors influencing the decision making in IPM.

**Methodology:** Lectures, cases of study, personal work, laboratory and field work

#### 6 IPM in Mediterranean fruit crops

180 Hours 6 ECTS

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Students will acquire knowledge on diagnosis of the main pests and natural enemies in citrus, stone and pome fruits, olive and grapevine. They will know the enough information to understand their biology, ecology and behavior. In the case of pests symptoms, damage levels and economic thresholds will be of concern. Other main objectives include the sampling techniques used to estimate population abundance and the decision criteria to select the most appropriate control measure in each case. They will also study the main fungi, bacteria, viruses, virus-like agents and nematodes affecting Mediterranean fruit crops, and the symptoms they cause. They will acquire experience about the main weeds on fruit crops.

**Methodology:** Lectures, cases of study, personal work, laboratory and field work

#### 7 IPM in practice: implementation, assessment and evaluation

90 Hours 3 ECTS

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Students will gain experience about documentation and Internet resources on Integrated Pest Management. They will design an IPM program in Mediterranean agriculture, studying practices cases on IPM program development, thresholds and timing of pest control actions. They will also learn about participatory research on Integrated Pest Management, how to do the extension of results and about Integrated Pest Management as a marketing tool.

**Methodology:** Lectures, cases of study, personal work, laboratory and field work, e-modules

#### 8 Languages

90 Hours 3 ECTS

**Module objectives (knowledge/skills acquisition, learning outcomes):**

Improvement of language competence, either language required for M1 or M2 local language.

**Methodology:** lectures and personal work.