



# **Integrated Pest Management of Mediterranean Fruit Tree Crops**

Organized by

Mediterranean Agronomic Institute of Bari

# Integrated Pest Management of Mediterranean Fruit Tree Crops

MAI coordinator: **Dr. Anna Maria D'Onghia**

## Objectives

The Master of Science in IPM of Mediterranean Fruit Tree Crops has been designed to train graduate agronomists and biologists in modern and sustainable integrated management of economically important pests affecting citrus, grapevine, olive, date palm, pome and stone fruits in the Mediterranean basin.

In order to prevent pests from reaching unacceptable levels, or to reduce existing pest populations to acceptable levels, emphasis is placed on all suitable techniques in a total management cropping system for a durable preservation of the environment and of natural resources.

The main objective of the Course is to prepare experts in IPM able to apply and transfer the following:

- the basic principles of IPM with emphasis on the bio intensive strategy for an effective management of undesirable pests present in the Mediterranean;
- the monitoring and identification of fruit trees key pests present in the Mediterranean;
- the use of certified propagating material, produced in the framework of the sanitary and clonal selection, as a compulsory proactive IPM strategy for the improvement of Mediterranean fruit crops;
- the monitoring and control of quarantine harmful pests;
- the sound management of key pests through the application of low environmental impact active control options;
- the application of the IPM strategy in the context of each specific Mediterranean fruit tree crop.

# Part 1

## Post graduate specialization program

Training is organized in 9 sections, preceded by an introductory module and including a Diploming *Croplife* Training for Trainers in IPM. (60 ECTS)

- Section I**                    **INTRODUCTORY DISCIPLINES**  
Introduction to scenarios of shared knowledge, research techniques and technology.  
Integrated pest management concepts.  
English language  
Diploming *Croplife* Training for trainers in IPM
- Section II**                    **IDENTIFICATION AND CONTROL OF BIOTIC AND ABIOTIC FACTORS**  
Introduction to the study of bacteria, fungi, nematodes, viruses, virus-like agents, insects, mites, weeds and physiological disorders.  
Morphology, physiology, life cycle, reproduction mechanisms and structures, taxonomy, diagnosis of pathogens and pests.  
Main conventional and non conventional control techniques for weeds, pests, and pathogens of Mediterranean fruit crops. Principles of biological and integrated management of plant pests and diseases.  
Main characteristics, requirements and limits to the use of pesticides, insecticides, herbicides. Plant tolerance and resistance to pests and diseases. Types and requirements of chemical treatments.  
Intervention threshold.
- Section III**                    **INTEGRATED PEST MANAGEMENT OF DATE PALMS**  
Main fungal, insects, mites and infectious diseases of date palm.  
Morphological, ecological, epidemiological, characteristics of pests, diseases and their agents. Detection and identification. Control techniques following an IPM approach.
- Section IV, V, VI, VII**      **INTEGRATED PEST MANAGEMENT OF OLIVE, CITRUS, FRUIT TREES, GRAPEVINE**  
Main bacterial, fungal, virus and virus-like diseases, insects, mites and nematodes of olive. Morphological, ecological, epidemiological, characteristics of pests, diseases and their agents. Detection and identification. Control techniques following an IPM approach.
- Section VIII**                **IPM FIELD APPLICATION**  
General overview of olive, citrus, fruit trees and grapevine diseases and pests with an integrated pest management approach.
- Section IX**                    **QUARANTINE AND CERTIFICATION PROGRAMMES**  
Principles and international norms for the quarantine of plant pests. The main quarantine pests affecting fruit trees crops of Mediterranean importance, the program for their monitoring and control. Principles and international norms of certification of propagating material of Mediterranean fruit crops. Sanitary selection scheme. List of pathogens and relative detection method included in the protocols for sanitary controls.
- Section X**                    **INDIVIDUAL PROJECT**  
Bibliographic review, design and application of IPM strategy relatively to a specific Mediterranean fruit tree crop.

## **TRAINING SEQUENCE**

**Section I**  
(6 ECTS)  
November

### **INTRODUCTORY DISCIPLINES**

IPM.I1 - Introduction to scenarios of shared knowledge, research techniques and technology (1 ECTS)  
IPM.I2 - Integrated pest management concepts (1 ECTS)  
IPM.I3 - English language (2 ECTS)  
IPM.I4 - Crop life -Training of IPM trainers course (2 ECTS)

**Section II**  
(14 ECTS)  
November - February

### **IDENTIFICATION AND CONTROL OF BIOTIC AND ABIOTIC FACTORS**

IPM. II1 - Physiological disorders, (1 ECTS)  
IPM. II2 - Insects, mites, nematodes and control (3 ECTS)  
IPM. II3 - Bacteria and control (2 ECTS)  
IPM. II4 - Viruses, virus-like agents and control (2 ECTS)  
IPM. II5 – Weeds and control (2 ECTS)  
IPM. II6 - Fungi, post harvest diseases and control (3 ECTS)  
IPM. II7 - Pesticides (1 ECTS)

**Section III**  
(3 ECTS)  
February

### **INTEGRATED PEST MANAGEMENT OF DATE PALMS**

IPM.III1 - Insects and mites (1 ECTS)  
IPM.III2 - Fungi and bacteria (1 ECTS)  
IPM.III3 - IPM review (1 ECTS)

**Section IV**  
(5 ECTS)  
February-March

### **INTEGRATED PEST MANAGEMENT OF OLIVE**

IPM. IV1 - Virus and virus-like agents (1 ECTS)  
IPM. IV2 - Fungi and bacteria (1 ECTS)  
IPM. IV3 - Insects, mites and nematodes (2 ECTS)  
IPM. IV4 - IPM review (1 ECTS)

**Section V**  
(7 ECTS)  
March-April

### **INTEGRATED PEST MANAGEMENT OF CITRUS**

IPM.V1 - Viruses and virus-like agents (2 ECTS)  
IPM.V2 - Fungi and bacteria (2 ECTS)  
IPM.V3 - Insects, mites and nematodes (2 ECTS)  
IPM.V4 - IPM review (1 ECTS)

**Section VI**  
(7 ECTS)  
April-May

### **INTEGRATED PEST MANAGEMENT OF FRUIT TREES**

IPM. VI1 - Viruses and virus-like agents of fruits trees (2 ECTS)  
IPM. VI2 - Fungi and bacteria (2 ECTS)  
IPM. VI3 - Insects, mites and nematodes (2 ECTS)  
IPM. VI4 - IPM review (1 ECTS)

**Section VII**  
(7 ECTS)  
May

### **INTEGRATED PEST MANAGEMENT OF GRAPEVINE**

IPM.VII1 - Viruses and virus-like agents (2 ECTS)  
IPM.VII2 - Fungi and bacteria (2 ECTS)  
IPM.VII3 - Insects, mites and nematodes (2 ECTS)  
IPM.VII4 - IPM review (1 ECTS)

**Section VIII**  
(2 ECTS)  
May-June

### **IPM FIELD APPLICATION**

IPM VIII1 - IPM field application of Olive, Citrus; Fruit trees, Grapevine

**Section IX**  
(5 ECTS)  
June

**QUARANTINE AND CERTIFICATION PROGRAMMES**

IPM.IX1 - Quarantine and legislation (1 ECTS)  
IPM.IX2 - Quarantine diseases monitoring (2 ECTS)  
IPM IX3 - Vectors monitoring (1 ECTS)  
IPM IX4 - Certification (1 ECTS)

**Section X**  
(4 ECTS)

**INDIVIDUAL PROJECT** (4 ECTS)  
*January - June*

**Comprehensive oral or written examination**

Participants take a written examination at the end of each unit. The exam is held in the classroom and includes problems, sets of questions, or exercises or a multiple choice test. Questions can also cover the seminar topics.

Participants may retake failed exams once, and up to 9 ECTS credits.

At the end of the course, participants shall take a comprehensive oral exam before an international jury, during which they shall also present and defend their project work.

To evaluate Section X, participants shall prepare a data base at the end of each unit (individual project), which is evaluated by the MAI B scientific staff.

Language of instruction: ENGLISH.

Simultaneous translation into French is provided.

## Analytical syllabus

### Section I      **INTRODUCTORY DISCIPLINES**

#### **IPM.I1 - Introduction to scenarios of shared knowledge, research techniques and technology**

Practical activities on: Multimedia Approach (Object processing, Editors, Structuring); Internet (the evolution of the network, Worldwide Web environment; Surfing activities, use of search engines, search strategies for information available on the web); distance learning.

Criteria for bibliographic search and the art of scientific writing. Organization of the MAIB Documentation Centre; Methods of bibliographic search; On-line data bank and strategies of bibliographic search at different hosts; Drawing up of the individual project and Master thesis.

#### **IPM.I2 - Integrated pest management concepts**

Introduction to technical issues (IPM for major pests of the various Mediterranean fruit tree crops) and to Institutional issues (policy, extension, farmers' perception, organization); management of the technical and organizational aspects IPM Classification of pesticides (insecticides, herbicides, fungicides), toxicity classification, mode of action. Development of resistance to modern fungicides and strategies for its avoidance. Organic pest control materials. Human injury, groundwater contamination, impact on non-target organisms. Pesticide use regulation.

#### **IPM.I3 - English language**

Oral skills improved through structured grammar practice and conversation exercises in groups and pairs; review of basic grammar structures; written exercises including grammar exercises, text comprehension and extended writing on various topics, including technical ones related to the course.

**ASSESSMENT METHODS:** Written exam.

#### **IPM.I4 - Crop life - Training of IPM trainers course**

Lectures and presentation of lessons set up by students.

Training model; approaches to training; circle of competence; learning theory; key processing styles; brain power; key learning styles; facilitating rainbow; facilitating; feedback; audiovisual support; flip tips; performance; body language; preparation to train; seating patterns; spot checks; evaluation; follow-up; training administration.

Presentation of lessons set up by students on a wide variety of Responsible Use subjects, including: IPM; compiling spray programs; pesticide storekeeping; protective clothing; pesticide formulations; pesticide application safety; maintenance and calibration of application machinery; pesticide waste disposal; safe transportation of pesticides; prevention and emergency measures for pesticide poisoning; protection of the environment; record keeping; scouting.

### Section II      **IDENTIFICATION AND CONTROL OF BIOTIC AND ABIOTIC FACTORS**

#### **IPM. II1 - Physiological disorders**

Nutritional deficiencies of fruit tree crops. Mineral nutrition; ecophysiology; macro and microelements deficiencies

## **IPM.II2 - Insects, mites, nematodes and control**

### ***Lectures, laboratory practices and field lecture***

Characteristics of plant parasitic insects: morphology; reproduction, ecology and epidemiology, principles of taxonomy. Classification of the major groups of plant parasitic insects. Biogeography. Types of interaction (competition, predation, mutualism). Life cycle of the main groups of plant parasitic insects.

Types of insect control: biological and integrated pest management. Key insects. Insect-plant interaction in the ecosystem. population dynamics. Intervention thresholds (economic and tolerance). Monitoring and sampling.

Types of traps. Control methods: chemical, genetic, physical, agronomic, mechanic. Main insecticide groups and type of action. Direct and indirect control methods

Characteristics of plant-parasitic nematodes: morphology; anatomy and biology. Nematode dissemination. Plant-nematode interactions. Classification and control of the major groups of plant parasitic nematodes.

## **IPM.II3 - Bacteria and Control**

### ***Lectures, laboratory practices and field lecture***

History; bacterial cell; taxonomy; genetics; pathogenicity; virulence and resistance; life cycle and dispersal of plant pathogenic bacteria; epidemiology, development of bacterial diseases; diagnosis. Control methods and biological features of phytopathogenic bacteria Types of inoculum and transportation. Cropping techniques (host eradication, sanitation, pruning, irrigation techniques, use of healthy plants, improvements of tree growth conditions, etc.). Use of resistant varieties and rootstocks. Chemical control: general features of fungicides and antibiotics, types of treatments, preparation and spraying of products, environmental conditions, Biological control (control of inoculum, protection of planting material, biological protection of leaves, fruits, flowers and branches, post-harvest). Physical control (soil disinfection, plant thermotherapy, refrigeration, radiation). Phytosanitary controls (import and export control measures, *in loco* controls).

## **IPM.II4 - Viruses, virus-like agents and control**

Definition, characteristics, shape and structure; multicomponentality; satellitism; localized and systemic infection; symptomatology and general characteristics of virus diseases; natural and artificial transmission; diagnosis by biological and laboratory methods; principles of control. Viroids; general characteristics and diseases. Phytoplasmas: general characteristics and diseases. Molecular aspects of viral particles; structure and expression of viral genome; structural and non structural proteins; infectious process in RNA and DNA viruses; cell to cell transfer; infectious process in viroids; molecular diagnosis and genetic engineering. Control.

## **IPM.II5 - Weeds and control**

### ***Lectures, laboratory practices and field lecture***

Classification and ecology of weeds. Dynamics and types of weed competition. Allelopathy. Chemical weed control. Intervention thresholds. Herbicides: classification, method of use, selectivity, formulation, application. Cultural practices for weed management. Biological weed control

### **IPM.II6 – Fungi, post harvest diseases and control**

#### ***Lectures, laboratory practices and field lecture***

Characteristics of plant pathogenic fungi: morphology; reproduction, ecology and epidemiology, principles of taxonomy. Classification of the major groups of plant pathogenic fungi. Criteria for the identification of plant pathogenic fungi. Main groups of fungicides: biological activity, mode of action, mechanism of action and side effects (resistance phenomena and residues on fruits and vegetables).

Control methods and biological features of phytopathogenic fungi (morphology, classification, biology and symptoms). Types of inoculum and transportation. Cropping techniques (host eradication, sanitation, pruning, irrigation techniques, use of healthy plants, improvement of tree growth conditions, etc.). Use of resistant varieties and rootstocks. Chemical control: general features of fungicides and antibiotics, types of treatments, preparation and spraying of products, environmental conditions, storage of pesticides. Biological control (control of inoculum, protection of planting material, biological protection of leaves, fruits, flowers and branches, post-harvest biological protection of fruits). Physical control (soil disinfection, plant thermotherapy, refrigeration, radiation). Phytosanitary controls (import and export control measures, *in loco* controls) Recognition and understanding of the cause of deterioration in Mediterranean fruits, main diseases and disorders emphasizing those of importance to international trade. Occurrence, symptoms, biology and control.

### **IPM.II7 – Pesticides**

#### ***Lectures and field lecture***

Classification of pesticides (insecticides, herbicides, fungicides) Toxicity classification. Mode of action. Formulation. Pesticide mixtures and incompatibility. Principles of uptake and systemic transport of pesticides within the plant. Development of resistance to modern fungicides and strategies for its avoidance. Damage to treated plants or surfaces. Adjuvant. Organic pest control materials. Hazard associated with pesticide use: human injury, groundwater contamination, impact on non-target organisms. Pesticide persistence and accumulation. Pesticide use regulation: analysis of some EU directives. Registration of pesticides in EU. Natural substances in biological control.

## **Section III INTEGRATED PEST MANAGEMENT OF DATE PALMS**

### **IPM.III1 – Insects and mites**

#### ***Lectures and laboratory practices***

Main parasitic insects of date palm. Morphology, biology, population dynamics, mortality factors, factors regulating infestations, damages, detection methods, control

### **IPM.III2 – Fungi and bacteria**

Main fungal, infectious diseases and physiological disorders of date palm. Detection, identification and control of disease agents.

### **IPM.III3 – IPM review**

IPM and certification of propagating material

## **Section IV INTEGRATED PEST MANAGEMENT OF OLIVE**

### **IPM.IV1 – Viruses and virus-like agents**

Generals on virus and virus-like diseases: symptomatology, epidemiology and ecology. Clonal and sanitary selection and registration. Certification of olive propagating material. Legislation on the commercialization of olive plant materials in EU countries (CAC).



## **IPM.IV2 - Fungi and bacteria**

### ***Lectures and field lecture***

Non parasitic diseases with special reference to unfavourable climatic conditions. Bacteria: *Pseudomonas syringae* pv. *savastanoi*. Fungi *Spilocaea oleagina* (Cast.) Hughes; *Glomerella cingolata* (Stonem.); *Mycocentrospora cladosporioides* (Sacc.); *Camarosporium dalmaticum* (Thum); *Verticillium dahliae* Kleb. Minor diseases and/or of limited spread: *Leivellula taurica* (Lev.) Arn.; 'Shoot necrosis' by *Phoma incopta* and *Eutypa lata* (Pers.) Tul. and Tul.; 'Foot and root rot' by *Armillaria mellea* (Wahl.). Trunk cankers and sooty mold. Integrated and biological control.

## **IPM.IV3 – Insects, mites and nematodes**

### ***Lectures, laboratory practicals and field lecture***

Key olive parasitic insects: *Bactrocera oleae* (Gmel.); *Prays oleae* (Bern.), *Saissetia oleae* (Oliv.). Morphology, biology, population dynamics, factors of mortality, factors regulating infestations, damages, detection methods, control. Secondary olive insects: *Liothrips oleae* (Costa), *Euphyllura olivina* (Costa), *Parlatoria oleae* (Colvée), *Palpita unionalis* (Hubn.), *Zeuzera pyrina* (L.), *Phloeotribus scarabeoides* (Bern.).

Olive pathogenic nematodes: Life cycle, symptoms, detection and control of: *Pratylenchus vulnus*, *P. penetrans*, *Rotylenchulus macrodoratus*, *R. reniformis*, *Meloidogyne incognita*, *M. javanica*, *M. arenaria*, *Helicotylenchus* spp., *Xiphinema diversicaudatum*. *Heterodera mediterranea*,

## **IPM.IV4 - IPM review**

General overview of olive diseases with an integrated pest management approach. *Field lecture*

## **Section V**

## **INTEGRATED PEST MANAGEMENT OF CITRUS**

### **IPM.V1 – Viruses and virus-like agents**

#### ***Lectures, laboratory practices and field lecture***

Principles of diagnosis and sanitation from virus, viroids and virus-like diseases, inoculation techniques and cultivation of indicator plants; specific diseases: Tristeza, Psorosis, Cristacortis, Impietratura, Concave Gum, Infectious variegation, Exocortis, Cachexia, *Satsuma dwarf virus*, Tatterleaf, Blight, Gummy bark, Bud-union disorders.

Citrus prokaryote diseases: General characteristics on phytoplasma-like organisms and bacteria-like organisms; epidemiology; Stubborn, Greening, Witches' broom and Citrus variegated chlorosis. Diagnostic methods, control

### **IPM.V2 - Fungi and bacteria**

#### ***Lectures, laboratory practices and field lecture***

Fungi and bacterial diseases; damping-off, root and foot rot; crown gummosis and brown rot; various gum cankers; anthracnose; mal secco; oil spots, canker. Diagnostics methods and control.

### **IPM.V3 – Insects, mites and nematodes**

**Lectures, laboratory practices and field lecture**

Citrus parasitic insects: *Dialeurodes citri* (Ashm.), *Aleurothrixus floccosus* (Mask.), *Parabemisia myricae* (Kuwana), aphids, *Planococcus citri* (Risso), *Saissetia oleae* (Oliv.), *Aonidiella aurantii* (Mask.), *Prays citri* (Mill.), *Phyllocnistis citrella* (Stainton), *Ceratitis capitata* (Wied.), mites (*Eriophyes sheldoni*, *Tetranychus urticae* and *Panonychus citri*). Morphology, biology, population dynamics, factors regulating infestations, damages, detection methods, control. Secondary citrus insects.

Citrus pathogenic nematodes: Life cycle, symptoms, detection and control of: *Tylenchulus semipenetrans*, *Radopholus citrophilus*, *Pratylenchus vulnus*, *P. penetrans*, *Rotylenchulus macrodoratus*, *Meloidogyne incognita*, *M. javanica*.

#### **IPM.V4 – IPM review**

General overview of citrus diseases with an integrated pest management approach. *Field lecture*

### **Section VI INTEGRATED PEST MANAGEMENT OF FRUIT TREES**

#### **IPM.VI1 - Viruses and virus-like agents**

##### ***Lectures and field lecture***

Identification and control: general and specific characteristics of virus and virus-like diseases; description of the main diseases and their causal agents (Ilarviruses, Nepoviruses, Closteroviruses, Sharka); diagnostic methods: (biological assays by means of softwood indicators and indexing to hardwood indicators); serological and molecular assays; comparison of the various methods and related problems; virus distribution in plants and strain variability; breeding for resistance (isolation and transfer of resistance genes, transgenic plants).

Identification and control: general and specific characteristics of virus and virus-like diseases of Pome fruits; description of the main diseases and their causal agents; diagnostic methods: comparison of the various methods and related problems; virus distribution in plants and strain variability;

General characteristics of prokaryote diseases. Description of the main diseases of fruit trees (apple proliferation, pear decline, European stone fruit yellows, etc.). Epidemiology and ecology of the main diseases. Detection methods for phytoplasmas: greenhouse indexing, DAPI method; ELISA, PCR or nested-PCR. Control of phytoplasma diseases.

#### **IPM.VI2 – Fungi and bacteria**

##### ***Lectures, Laboratory practicals and field lecture***

Plant pathogenic fungi. Root, crown. Trunk and shoot diseases (*Phytophthora* spp; *Valsa* spp. = *Cytospora* spp.; *Fusicoccum amygdali*; *Verticillium dahliae*; *Armillaria mellea*). Leaf, flower and fruit diseases (*Taphrina* spp; *Monilia* spp; *Venturia carpophila*; *Botrytis cinerea*; *Coryneum beijeriinkii*; *Gloesporium amygdalinum*; *Tanzshelia pruni-spinosae*; *Stereum purpureum*). Importance of bacterial diseases in the Mediterranean basin; symptoms; description of pathogens; disease cycle; control strategies; (*Pseudomonas amygdali*, *P. syringae* pv. *Mors prunorum*, *Ps. Pv. Syringae*, *Xanthomonas pruni*, *P. viridiflava*, *P. persicae*).

#### **IPM.VI3 – Insects, mites and nematodes**

##### ***Lectures, laboratory practices and field lecture***

Key parasitic insects of stone and pome fruits: *Taeniothrips meridionalis*, *Frankliniella occidentalis*, *Mizus persicae*, *Pseudalacaspis pentagona*, *Quadropsidiotus perniciosus*, *Anarsia lineatella*, *Cydia molesta*, *Ceratitis capitata*. Morphology, biology, population dynamics, mortality factors, factors regulating infestations, damages, detection methods, control. Secondary insects: Aphids, *Argyrotaenia pulchellana*, *phyllonorycter cerasicolella*, *Euzophera bigella*, *Empoasca decedens*, *Rhyncota* spp.

Plant pathogenic nematodes and virus vectors of stone and pome fruits. Life cycle, symptoms, detection and control of: *Meloidogyne* spp. (*M. arenaria*, *M. hapla*, *M. incognita*, *M. javanica*, *M. ispanica*), *Pratylenchus* spp., *Criconomella* spp., *Paratylenchus* spp., *Xiphinema* spp., *Longidorus* spp.

#### **IPM.VI4 – IPM review**

General overview of fruit trees diseases with an integrated pest management approach. *Field lecture*

### **Section VII INTEGRATED PEST MANAGEMENT OF GRAPEVINE**

#### **IPM.VII1 – Viruses and virus-like agents**

##### ***Lectures and field lecture***

General characteristics of virus and virus-like, viroid, intracellular prokaryote diseases: symptomatology, epidemiology and ecology; virus diseases (fanleaf, leaf roll, rugose wood complex; fleck, virus diseases induced by other mechanically-transmissible viruses); virus-like diseases (enations, vein necrosis, vein mosaic, bushy stunt, graft incompatibility); viroid diseases (yellow speckle); intracellular prokaryote diseases (“Yellows”, Golden Flavescence, Pierce’s disease).

#### **IPM.VII2 – Fungi and bacteria**

##### ***Lectures, laboratory practices and field lecture***

General characteristics of fungal diseases; root and wood rot agents; diseases of the epigeal part; strategies of supervised control. Plant pathogenic fungi. *Plasmopara viticola*, *Uncinula necator*, *Botryotinia fuckeliana*, *Phomopsis viticola*, Esca disease agents (*Fomitiporia* (= *Phellineus*) *punctata*, *Phaeoacremonium chlamydospora*, *P. aleophilum*), *Armillariella mellea*, *Rosellinia necatrix*, *Verticillium dahliae*, marciume acido agents (species of *Alternaria*, *Aspergillus*, *Cladosporium*, *Mucor*, *Penicillium*, *Rhizopus* genera), *Eutypa lata*,

#### **IPM.VII3 – Insects, mites and nematodes**

##### ***Lectures, laboratory practices and field lecture***

Key parasitic insects: Lepidoptera (*Lobesia botrana*, *Eupoecilia* (= *Clysia*) *ambiguella*, *Cryptoblales gnidiella*, *Holocacista rivillei*, Miridae (*Lygus spinolai*), Homoptera (*Metcalfa pruinosa*, *Empoasca vitis*, *Jacobiasca libica*, *Scaphoideus titanus*, *Hyalestes obsoletus*), Aphidoidea (*Viteus vitifoliae*), Pseudococcidae (*Planococcus citri*, *P. ficus*, *Pseudococcus longispinus*), Coccidae (*Pulvinaria vitis*, *Parthenolecanium corni*), Scarabeidae (*Tropinota punctatus*, *T. squallida*, *Anomala vitis*), Bostrychidae (*Sinoxylon perforans*, *S. sexdentatum*, etc.), Isoptera (*Calotermes flavicollis*, *Frankliniella occidentalis*, *Drepanothrips reuteri*) mites (*Panonychus ulmi*, *Tetranychus urticae*, *Eotetranychus carpini vitis*) Eriophies (*Calopitrimerus vitis*, *Colomerus vitis*) Morphology, biology, population dynamics, factors of mortality, factors regulating infestations, damages, detection methods, control.

Plant pathogenic nematodes and virus vectors of grapevine; Life cycle, symptoms, detection and control of: Meloidogyne spp. (*M. arenaria*, *M. incognita*, *M. javanica*, *M. hapla*), Pratylenchus spp. (*P. vulnus*, *P. penetrans*), Tylenchulus semipenetrans, Helycotilenchus spp., Xiphinema spp. (*X. index*, *X. diversicaudatum*, *X. italiae*, etc.), Longidorus spp. Paratrichodorus christei, Rotylenchulus macrodoratus

#### **IPM.VII4 – IPM review**

General overview of grapevine diseases with an integrated pest management approach. *Field lecture*

### **Section VIII IPM FIELD APPLICATION**

#### **IPM.VIII1 – IPM field application of olive; citrus, fruits trees, grapevine**

General overview of Olive, citrus, fruit trees and grapevine diseases with an integrated pest management approach in the field.

## **Section IX      QUARANTINE AND CERTIFICATION PROGRAMMES**

### **IPM.IX1 – Quarantine and legislation**

History, philosophy and quarantine procedures; regulations; pest risk assessment; inspections, treatments, certification and surveys; quarantine aspects of vegetatively propagated crops, including post-entry quarantine.

### **IPM.IX2 – Quarantine diseases monitoring**

#### ***Lectures and field lecture***

Overview, schemes and methods applied for monitoring of the main quarantine pests affecting fruit trees crops of Mediterranean importance. Programme for their monitoring and control.

### **IPM.IX3 – Vectors monitoring**

#### ***Lectures and field lecture***

Overview, schemes and methods applied for monitoring of the main vectors of the quarantine pests, affecting fruit trees crops of Mediterranean importance. Programme for their monitoring and control.

### **IPM. IX4 – Certification**

#### ***Lectures and field lecture***

Clonal and sanitary selection: sanitation, evaluation of candidate clones in comparative fields; registration of clones. Primary sources. Certification of plant propagation material: principles and phases. Organization of a certification service. Characteristic of structures and fields in a certification program. Genetic and sanitary controls.

## **Section X      INDIVIDUAL PROJECTS**

Throughout the Course, participants carry out an individual project on IPM topics, also related to a specific fruit crop species. This project enables participants to:

- (i) apply the principles and methodology presented during the Course;
- (ii) gain experience in finding technical and scientific information, as well as learn how to apply a bibliographic review and prepare a data base;
- (iii) make a critical assessment of different pest management strategies;
- (iv) acquire experience in the preparation of oral communication and public speaking and presentation.

## Part 2

### The Master of Science Program

Project (12 months duration, 60 ECTS)

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

- **Viruses, viroid, phytoplasma and virus-like diseases** of Mediterranean fruit tree crops (citrus, grapevine, olive, stone and pome fruits): characterization (biological, physico-chemical and molecular), epidemiology, diagnosis (biological, serological and molecular), distribution and incidence in Mediterranean countries, sanitation.
- **Fungal and bacterial diseases** of Mediterranean fruit tree crops (citrus, grapevine, olive, stone and pome fruits): characterization, epidemiology, diagnosis (biological, serological and molecular). Biological control. Toxins of fungal origin.
- **Nematodes and insects**; Surveys, Characterization (biological, and molecular), Epidemiology, Role in virus transmission.

#### INDICATIVE MASTER THESES REALIZED WITHIN THE AREA

**Title:** Interaction between wild plants, arthropods and their natural enemies in citrus orchards in Morocco. Morocco 2008

**Author:** Kaoutar Karori (Morocco)

**Place of implementation:** DPVCTRF Morocco– IAM-Bari, Italy.

**Thesis directors:** Jamila Wadjiny, Paolo Barberi, *Jenny Calabrese and. Smaili Moulay Chrif*

**Title:** Assessment on the presence of citrus tristeza virus (CTV) and relative vectors in Syria. Syria (2006)

**Author:** Raied Abou Kubaa (Syria)

**Place of implementation:** Citrus Research Center Tartous (Syria) – IAM-Bari, Italy.

**Thesis directors:** Anna Maria D'Onghia, Fawwaz Azmeh, Rocco Addante

**Title:** Assessment of the sanitary conditions of certified nurseries production in Souss Massa Valley, Morocco (2005)

**Author:** Ali El Aimani (Morocco)

**Place of implementation:** IAV Hassan II Agadir, Pépinières Kebbaje (Morocco); IAM-Bari, Italy

**Thesis directors:** Mohamed Achouri and Khaled Djelouah

**Title:** Sanitary status of stone fruits trees and typing of Plum pox virus isolates in Bosnia and Herzegovina (2004)

**Author:** Slavica Matic (Bosnia and Herzegovina)

**Place of implementation:** IAM-Bari, Italy

**Thesis director:** Arben Myrta

**Title:** Comparison between real-time Scorpion PCR and traditional methods for the detection and quantification of *Verticillium dahliae* in soils and in infected olive trees (2003)

**Author:** Barham Hazar, Palestine

**Place of implementation:** University of Bari, Italy

**Thesis directors:** Antonio Ippolito and Franco Nigro

**Title:** Characterization of two nepoviruses isolated from Turkish grapevines (2002)

**Author:** Gokalp Kadir, Turkey

**Place of implementation:** IAM-Bari, Italy

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**Title:** Etude de l'incidence et de la distribution du virus de la psorose des agrumes (CPV) au Maroc par « DTBIA » et caractérisation partielle de quelques souches locales de CPV (2001)

**Author:** Mrani Naima, Morocco

**Place of implementation:** IAM-Bari; Domaines Agricoles – UCP of Hassaine, Morocco

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**Title:** Genetic variability in *Uncinula necator* (Schw.) Burr. (*Oidium tuckery* Berk.) (2000)

**Author:** Hajaj Ramadan Hajjeh, Palestine

**Place of implementation:** University of Bari, Italy

**Thesis directors:** Francesco Faretra and Vito Piglionica

**Title:** Production and characterization of monoclonal antibodies specific to GLRaV-2, GLRaV-6 and GVD (1999)

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**Place of implementation:** University of Bari, Italy

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