

## COURSE SYLLABUS 2019-20

Basic information on the course			
Course:	Insect Diagnostics and Biological Control		
Course code:	70784244	Plan:	Máster en Horticultura Mediterránea bajo Invernadero
Academic Year:	2019-20	Undergraduate/Graduate:	Máster Universitario Oficial
Degree Year:	1	Type:	Optional subject
Duration:	Second four-month period		
TIME DISTRIBUTION ACCORDING TO REGULATIONS			
Credits:	3.0		
Total time:	75		
<b>USE OF LEARNING PLATFORM:</b>	Multimodal		

TEACHERS			
Name	Cabello García, Tomás		
Department	Dpto. de Biología y Geología		
Building	Edificio Científico Técnico II – B. Ground floor		
Office	0.022		
Telephone	+34 950015001	E-mail (institutional)	tcabello@ual.es
Website	<a href="http://cms.ual.es/UAL/personas/persona.htm?id=514852485548495287">http://cms.ual.es/UAL/personas/persona.htm?id=514852485548495287</a>		
Name	Barranco Vega, Pablo		
Department	Dpto. de Biología y Geología		
Building	Edificio Científico Técnico II – B. Ground floor		
Office	0.021		
Telephone	+34 950015888	E-mail (institutional)	pbvega@ual.es
Website	<a href="http://cms.ual.es/UAL/personas/persona.htm?id=505553494953535681">http://cms.ual.es/UAL/personas/persona.htm?id=505553494953535681</a>		
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## OTHER IMPORTANT INFORMATION

### Content justification

Biological control of crop pests is becoming increasingly important worldwide, covering an area of 34 million hectares. Within the same, Almeria (Spain) is the area that concentrates the largest area of use of biological control in greenhouses (26,720.00 hectares estimated for the 2013/14 crop cycle), which represents annually an economic volume of natural enemies used of 50 million euros, equal to the volume of pesticide products, which are used (mainly fungicides) in the nearly 27,000 hectares of such crops in the province. The use of biological control involves three phases or processes: the design of the biological control program, the production of natural enemies in bio-factory conditions and, finally, its practical application in greenhouse crops. All this presents a greater complexity than the old methods of chemical control of pests and diseases; according to it the matter has been structured, through its content, in four sections. Two of the basic theoretical contents that comprise, on the one hand, the knowledge about the natural pest control agents (predators, parasitoids and entomopathogens), on the other hand, in their rearing (in bio-factories), handling and use. Two other sections refer to practical knowledge divided into the identification of these agents and its evaluation; together with the realization of practices of use of biological control in horticultural crops greenhouses. The content of the subject is complemented by other activities that affect specific aspects of the subject, e.g. evaluation of effectiveness of biological control agents, quality control of biological control agents, etc.

Courses related in Study Plan: 70781101 Introducción a la Horticultura en Invernadero. 70782215 Protección de Cultivos. 70783102 Tecnología y Gestión aplicada a la Horticultura. 70785401 Trabajo Fin de Máster

Pre-required knowledge: Agricultura Entomology

## COMPETENCES

### Basic and general competences

#### *Basic and general competences*

- Understanding and possessing knowledge
- Application of knowledge

#### *Key competences University of Almeria*

- Ability to solve problems
- Capacity for criticism and self-criticism
- Teamwork
- Ability to learn to work independently

### Specific competences

- Capacity for the development of biological pest control programmes in horticultural crops in greenhouses.
- Capacity for the technical management of the application of biological control programmes in horticultural crops in greenhouses.

- Capacity for the production of natural enemies under bio-factory conditions.

## LEARNING OUTCOMES

1. **Informative objectives:** To know the elements that make up biological pest control programmes, as well as the stages of its development. To study the biological, ecological, economic and agronomic fundamentals of the methods of biological pest control. To study and know the natural enemies of arthropod pests: predators, parasitoids and entomopathogens. Know the methods of applying biological pest control. To know the applications of the mathematical models in the application of the biological pest control.
2. **Training objectives:** To identify the most important species of predators, parasitoids and entomopathogens as natural control agents. To be able to establish the biotic potential of an arthropod (predatory or/and parasitoid species). Know how to apply biological pest control. Knowledge of entomophagous and entomopathogenic rearing techniques.

## CONTENTS

### Theoretical Blocks

#### Block I: Biological Control agents of pest species

**Theme 0: Introduction: Scope and nature of biological control.** Introduction. Historical developments. Types of biological control by the target. Concepts and terminology: comparative aspects. Biological pest control

**Theme 1: Predatory arthropods as biological control agents.** Introduction. Historical background. Characteristics of the predatory mites and insects. Classification of predatory arthropods.

**Theme 2: Parasitoid species as biological control agents.** Introduction and definitions. Characteristics of parasitoid species. Host-parasitoid relationship. Parasitoid groups. Parasitoid biology. Impact of parasitoid species.

**Theme 3: Entomopathogens as biological control agents.** Introduction. Characteristics of entomopathogens. Main groups of entomopathogens. Impact of entomopathogens.

#### Block II: Use of natural enemies of pest species

**Theme 4: Biological control by introduction of exotic entomophagous species.** Introduction. Review and evaluation of available information. Selection of target organism and exploration area. Inventory and research on selected species. Import of natural enemies. Post-import procedures. Quarantine. Establishment and colonizing. Evaluation. Regulations: Code of Good Practices (F.A.O.).

**Theme 5: Biological control by augmentation of entomophagous species.** Introduction. Non-efficiency of entomophagous: factors. Project development. Methods of entomophagous manipulation. Periodic colonization procedures. Inoculative releases. Massive releases. Improvement of entomophagous species. Other methods. Storage, transport and release. Environmental impact.

#### Block III: Production and evaluation of entomophagous species and entomopathogens

**Theme 6: Rearing of entomophagous species.** Quality control. Introduction. Rearing of entomophagous species. System design. Facilities for the arthropod rearing. Problems in arthropod rearing. Quality control.

**Theme 7: Efficiency evaluation of entomophagous species.** Introduction and objectives. Classification of the evaluation methods of entomophagous species. Indirect estimation of entomophagous efficiency.

**Theme 8: Entomopathogen production and efficacy evaluation.** Introduction. Production of entomopathogens. Formulation and application of entomopathogens. Efficacy evaluation: Bioassays.

### Practical Block

**Session 1: Technical visit in the Almería greenhouses' area:** Use of predatory and parasitoid in commercial greenhouse crops.

## COMPETENCY ASSESSMENT

### Criteria and assessment tools

Learning procedures and activities: The course has 50 percent presential and 50 percent online. The attendance section includes an introduction to the theoretical themes and a technical visit. Students must complete their work with the material available online.

Grading: your final grade will be based on online tests ( $\leq 6.0$  points), classroom attendance ( $\leq 2.0$  points), technical visit attendance ( $\leq 1.5$  points), and submission of technical visit report ( $\leq 0.5$  points). Optionally, the students will be able to carry out assignments of the type bibliographic work in specific cases of the matter (extra points).

### Follow-Up Mechanisms

- Attendance and participation in classroom activities.
- Online tests evaluation.
- Submission of learning activities.
- Submission of learning activities for field work.

### Functional diversity / Functional disability.

- Those students with disabilities or special educational needs can get in contact with the Delegation of the Rector for the Functional Diversity (<http://www.ual.es/discapacidad>) to receive the appropriate guidance and advice in order to facilitate their instructional, learning and training processes. Likewise, these students may request the implementation of the necessary and suitable adaptations of content, methodology and evaluation that guarantee equal opportunities in their academic development. The processing of any personal data or aggregated information regarding these aforementioned students, in fully compliance with the GDPR, is strictly confidential. Faculties and academic staff lecturing the course referenced by this guide/document will be in charge of applying the recommended adaptations approved by the Delegation of the Rector for

the Functional Diversity, this fact will be, therefore, notified to the School or Faculty as well as to the coordinator of the academic course.

## COURSE MATERIALS

### Recommended course materials

#### *Basic*

Driesche, B.G. van; Hoddle, M.S.; Centre, T.D. Control de plagas y malezas por enemigos naturales. USDA-ARS. 2007.

Morales-Ramos, J.A.; Rojas, M.G.; Shapiro-Ilan, D.I. Mass production of beneficial organisms: Invertebrates and entomopathogens.. Elsevier. 2014.

Bellows, Th.S.; Fisher, T.W. Handbook of Biological Control. . Academic Press. 1999.

#### *Complementaria*

Jacas, J.; Urbaneja, A.. Control biológico de plagas. Phytoma España. 2009.

Torres, I; Guevara, R.. Biosystems engineering: Biofactories for food production in the XXI Century. Springer. 2014.

Didgway, R.L.; Vinson, S.B. (Eds.). Biological control by augmentation of natural enemies. Plenum Press. 1977.

Boucias, D.G.; Pendland, J.C. The Principles of insect pathology.. Kluwe. 1999.

Butt, T.M.; Jackson, C.W.; Magan, N.. Fungi as biocontrol agents: progress, problems and potential. . CABI Publ.. 2001.

Caballero, P.; Ferré, J.. Bioinsecticidas: fundamentos y aplicaciones de Bacillus thuringiensis en el control integrado de plagas.. Universidad Pública de Navarra y Phytoma. 2001.

Caballero, P.; López-Ferber, M.; Williams, T.. Los Baculovirus y sus aplicaciones como bioinsecticidas en el control biológico de plagas. . Universidad Pública de Navarra y Phytoma.. 2001.

Charles, J.F.; Delécluse, A.; Nielsen-LeRoux, Ch.. Entomopathogenic bacteria: From laboratory to field application. . Kluwer Academic Publishers.. 2000.

Grewal, P.S.; Ehlers, R.U.; Shapiro-Ilan. D.I. . Nematodes as Biocontrol Agents.. CABI Publ.. 2005.

Ravensberg, W.J. . A roadmap to the successful development and commercialization of microbial pest control products for control of arthropods. . Springer. 2011.

Rolff, J.; Reynolds, S.E. . Insect Infection and Immunity: Evolution, Ecology, and Mechanisms. . Oxford University Press. 2009.

Charlet, L.D.; Brewer, G.J.. Biological control of native or indigenous pests: Challenges, constraints, and potential. . Entomological Society of America. 1999.

Nicot, P.C. . Classical and augmentative biological control against diseases and pests: critical status analysis and review of factors influencing their success. . Nicot, P.C. (Ed.) 2011. Classical and augmentative biological control against diseases and pests: critical status analysis and review of factors influencing their success. IOBC wprs. 2011.

Anderson, T.E.; Leppla, N.C. . Advances in Insect Rearing for Research and Pest Management. . Westview Press. 1992.

Cohen, A.C.. Insect diets: Science and technology. . CRC Press. 2003.

Lenteren, J.C. van . Quality control and biological control agents: Theory and testing procedures. . CABI Publishing. 2003.

Panizzi, A.R.; Parra, J.R.P. . Insect bioecology and nutrition for integrated pest management. . CRC Press. . 2012.

Ridgway, R.L.; Hoffmann, M.P.; Inscoc, M.N.; Glenister, C.S. . Mass-reared natural enemies: Application, regulation, and needs. . Thomas Say Publications in Entomology. 1998.

Singh, P.; Moore, R.F. . Handbook of insect rearing. Vol I y II. . Elsevier. 1985.

#### *Other bibliography*

Narang, S.K.; Bartlett, A.C.; Faust, R.M.. Applications of genetics to arthropods of biological control significance. CRC Press. 2018.

Krantz, G.W.; Walter, D.E.. A manual of acarology. Texas Tech University Press. 2009.

Mason, P.G.; Gillespie, D.R.; Vicent, Ch.. Proceedings of the 5th international symposium on biological control of arthropods. CABI International. 2017.

Poinar, G.O.. Nematodes for biological control of insects. CRC Press. 2018.

Lacey, L.A.. Microbial control of insect and mite pests: from theory to practice. Academic Press. 2017.

Driesche, R. van, Simberloff, D., Blossey, B. et al.. Integrating biological control into conservation practice. Wiley Blackwell. 2016.

### Couse materials available in UAL's library

The current bibliography can be found in the UAL library at the following address:

<http://almirez.ual.es/search/e?SEARCH=DIAGNOSTICO Y CONTROL BIOLOGICO DE PLAGAS EN CULTIVOS PROTEGIDOS>

### WEBSITE

- <http://scholar.google.es/citations?hl=es&user=aRXlx7UAAAAJ>

*Web Google Académico: T. Cabello*

- <http://www.ibma.ch/>

*International Biocontrol Manufacturers Association*

- <http://www.iobc-global.org/>

*International Organization for Biological Control (IOBC)*

- <http://www.magrama.gob.es/agricultura/pags/fitos/registro/fichas/pdf/RegistroOCB.pdf>

*Registry of biological control organisms. Ministry of Agriculture, Food and Environment, Spain.*

- [http://www.iobc-wprs.org/expert\\_groups/03\\_wg\\_insect\\_pathogens.html](http://www.iobc-wprs.org/expert_groups/03_wg_insect_pathogens.html)

*IOBC wprs. Insect pathogens and entomoparasitic nematodes*