



## SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Teaching Language
BIO	457	Biological Control	3	2	2	0	4-6	BIO 353	8	English

### A. Course Description

The ecological principles and applied practices of modern biological control of insects, weeds and plant pathogens; including the history, scope, strengths and weaknesses, scientific basis of biological control, the biology of entomophagous insects, insect pathogens, microbial control, biological control methods, population ecology as it relates to biological control, biological control in integrated pest management, techniques and protocols in implementation of control programs and related topics.

### B. Course Outcomes

At the end of this course the student will be able to:

1. Have a broad knowledge about the importance and definition of pests.
2. Have abroad knowledge about the identification and classification of the most important medically and economically insects pest in KSA and worldwide.
3. Appreciate the basis and implications of the theory of natural enemies.
4. Appreciate and describe the techniques implemented in biological control.
5. Understand the different types of biological control.
6. Appreciate the use of the different biocontrol agents (including parasites, parasitoids, and microorganisms)in controlling pests.

### C. References:

#### Required Textbook

- Hajek A. E (2004). *Natural Enemies*. Cambridge University Press.
- Flint M. L. and. Driestadt S. H. (1998). *Natural Enemies Handbook: The illustrated guide to biological pest control*. University of California Division of Agriculture and Natural Resources.
- Van Driesche R. G. and Bellows T. S Jr. (1996). *Biological Control*. Chapman and Hall, New York, New YorkVan den Bosch R., Messenger P. S. and Gutierrez A. P. (1982). *An Introduction to Biological Control*. Plenum, N.Y.
- Bellows T. S. and T. W. Fisher. (1999). *Handbook of Biological Control*. Academic Press. San Diego.
- Debach P. and Rosen Y D. (1991). *Biological control by natural enemies*. 2nd. Ed. Cambridge. Univ. Press, Cambridge, N.Y.

#### Other references:

- Roy Van Driescheand Thomas S.Bellows Jr.1996.Biological control.
- Vincent et al.(2007).Biological Control:A Global Perspective.CAB International.
- G.Gurr,S.S..Wratten(eds.)(2000).Biological Control:Measures of Success.Kluwer Academic Publishers

**Course Website:** Google Classroom Webpage: <http://www.imamm.org/>



## D. Topics Outline

### D1. Lectures topics

#### 1. **Biological control of plant pathogens:**

*Definitions, history, and importance of biological control.*

*Biological control of bacterial pathogens on aerial surfaces:*

*Bacterial pathogens of blossoms.*

*eg. Erwinia amylovora; russet-inducing bacteria.*

*Bacterial pathogens of leaves.*

*eg. Pseudomonas syringae and the INA concept; Xanthomonas campestris. The disease triangle and disease cycles. How do diseases affect plants?*

#### 2. **Biological control of fungal pathogens on aerial surfaces :**

*Ecology in the leaf surface Necrotrophic fungal pathogens.*

*eg. Botrytis cinerea - bacterial biocontrol agents and Trichoderma Sclerotinia sclerotiorum.*

*Biotrophic fungal pathogens.*

*eg. Rusts - bacterial biocontrol agents.*

*Powdery mildews - bacterial biocontrol agents and Ampelomyces*

*Virus and induced systemic resistance. Diseases caused by Myxomycetes.*

#### 3. **Biological control of soil - borne pathogens and concepts of biotechnology :**

*Bacterial pathogens.*

*eg. Agrobacterium tumefaciens - A. radiobacter K84 and K1026 and Ralstonia*

*(=Pseudomonas) solanacearum - an example of pleiotropism and the transference of resistant gene.*

*Fungal pathogens.*

*eg. Fusarium spp. - bacterial biocontrol agents and nonpathogenic fusaria.*

*Rhizoctonia solani - bacterial agents and nonpathogenic Rhizoctonia*

*Pythium spp. - bacterial biocontrol agents and hyperparasitic Pythium spp.*

*Biological control of post-harvest pathogens :*

*Bacterial pathogens eg. Erwinia carotovora soft-rots.*

*Fungal pathogens Monilinia on peaches, Mucor and Rhizopus on apple and pear.*

*Mechanisms of biological control of plant pathogens:*

*Competition for nutrients.*

*E.g. competition between pathogenic and nonpathogenic fungi.*

*Competition for iron and the role of siderophores.*

*Competition for fungal germination stimulants.*

*Antibiosis.- Lytic enzymes.- Induced systemic resistance.*

*Cross protection.- Hyperparasitism.- Hypovirulence.*

#### 4. **Biological control of nematodes using microorganisms:**

*Bacterial parasites and Rhizobacteria (PGPR or YIB).*



*E.g. Pasteuria penetrans, Ralstonia (=Burkholderia) cepacia.*

*Fungal parasites eg. Paecilomyces lilacinus.*

*and Verticillium clamydosporum, etc.*

*Nematode trapping fungi.*

*E.g., Arthrobotrys oligospora.*

*Mycorrhiza and endophytic bacteria.*

*Trap and antagonistic crops, organic amendments and rotations.*

## **5. Biological control of insects:**

### **Definitions and importance.**

*Parasitoids definitions and examples: eg. Trichogramma; Apanteles.*

*Predators : eg. Chrysopa, Hippodamia, etc.*

*Biology, ecology, and population dynamics.*

*Microbial Control.*

*Bacteria: eg. Bacillus thuringiensis; B. popilliae.*

*Viruses: eg. Nucleopolyhedrosis and granulosis viruses.*

*Fungi: eg. Entomophthora, Beauveria.*

## **6. Biological control using entomopathogenic nematodes Introduction:**

*Steinenema, Heterorhabditis. Mode of action.*

*Production and formulation.*

*Application and commercialization.*

*Biological control of weed using insects:*

*Use of insects to control weeds in agronomic lands.*

*Chrysolina quadrigemina on Klamath weed.*

*Use of insects/fish to control aquatic weeds.*

*eg. Agasicles hygrophila on alligatorweed.*

*Ctenopharyngodon idella on many aquatic weed species.*

## **7. Industry and commercialization:**

*Technology transfer.*

*Market size and marketability.*

*Timely availability and shelf-life.*

*Consumer acceptance of produce protected by non-engineered and engineered biocontrol agents:*

*Cost/benefit ratio.*

## **D2. Laboratories topics**

**1. Introduction:** *General tools, materials, and equipment.*

**2. Sampling methods.**

**3. Isolation and purification of biological control agents.**

**4. Antibiosis assays in vitro and tests of antagonisms.**

**5. Assays with biological control agents I.**

**6. Assays with biological control agents II.**

**7. Natural enemies of nematodes.**

**8. Tests with organic extracts.**



9. *Sampling and observations of natural enemies of insects.*
10. *Parasites, parasitoids, and predators of insects.*
11. *Functional response.*
12. *General revision.*

#### E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

#### F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm 1:** 6<sup>th</sup> or 7<sup>th</sup> week.
- **Midterm 2:** 11<sup>th</sup> or 12<sup>th</sup> week.
- **Quizzes & Homeworks:** During the semester.
- **Final lab. Exam :** 14<sup>th</sup> or 15<sup>th</sup> week.
- **Final Exam** : 16<sup>th</sup> week.

Your course grade will be based on your semester work as follows:

<b>Midterm 1: 15 %</b>	<b>Midterm 2: 15 %</b>	<b>Final lab. Exam: 20%</b>	<b>Final Exam: 40 %</b>
<b>Quizzes, Homework, Attendance &amp; Participation: 10 %</b>			

The grading distribution:

<b>A+</b>	<b>A</b>	<b>B+</b>	<b>B</b>	<b>C+</b>	<b>C</b>	<b>D+</b>	<b>D</b>	<b>F</b>
[95, 100]	[90, 95]	[85, 90]	[80, 85]	[75, 80]	[70, 75]	[65, 70]	[60, 65]	[0, 60]

#### G. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. (“Immediate family” is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

[Executive Rules for Study Regulations and Exams](#)

[goo.gl/ykm7t3](http://goo.gl/ykm7t3)

