University of Zagreb Faculty of Agriculture
Svetošimunska cesta 25, 10000 Zagreb
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Natural enemies and principles of biological control (296608)

Course coordinator

Prof. Renata Bažok, PhD

Course description

Environmentally friendly plant protection measures are those measures where the professional applications are not dangerous to humans and beneficial organisms, which do not contaminate (or only shortly contaminate, but never pollute) environment, which minimally disrupt the balance between organisms and have the least negative impact on the diversity of species in nature, which means that they maximally preserve biodiversity. Species that should be mostly preserved in animal fauna are useful species ie. natural enemies of pests. The module will introduce students to the biology and ecology of natural enemies and potential possibilities of their use for the purpose of biological control. After a historical review, biological control methods will be discussed in details, as well as the utility threshold and some other specifics. Module will give an overview of today's situation in the world and in Croatia, and the real possibilities of using natural enemies in the open and indoors (glasshouses, greenhouses). Special attention will be pointed on all the advantages: no application of pesticides, no pesticide residues in the soil, environment and food, there is no possibility of human poisoning and soem other specifics. Through auditory exercises, students will learn about the most important morphological characteristics of systematic groups of natural enemies.

ECTS: **3.00**

E-learning: **L1**

Teaching hours: 30
Lectures: 16
Laboratory exercises: 4
Seminar: 10

Lecturer

- Prof. Renata Bažok, PhD
- Assoc. Prof. Maja Čačija, PhD

Associate teacher for exercises

- Assoc. Prof. Maja Čačija, PhD
- Prof. Renata Bažok, PhD
- Helena Virić Gašparić, PhD

Grading

Sufficient (2): 64-72%
Good (3): 73-80%
Very good (4): 81-90%
Excellent (5): >91%

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Type of course

- Graduate studies / MS Courses taught in English (Elective course, 1 semester, 1 year)

General competencies

Upon completion of the module students will be able to apply the acquired knowledge in theory and practice, will be able to argue and solve the problem, to manage the new situations, generate new ideas and will have the ability of team learning. The course enables the understanding of the possibilities and ways of using natural enemies for biological pest control. Based on the given conditions in the field / greenhouse (a type of pest, the intensity of the attack, the development stage, type of building, ecological conditions of releasing), students will be able to choose the best type of natural enemy, the best method and time of releasing the enemy to achieve the maximum success in biological control.

Types of instruction

- Lectures
- Practicum
  As part of the practicum, two exercises on the morphology of insects are carried out. The first exercise describes the morphology of natural enemies from the Heterometabola group and the second exercise from the Holometabola group. Students independently study entomological material using binoculars and make drawings. Exercises are performed in groups (six groups of 10 to 12 students).
- Seminars
  The seminar is based on the most important groups and species of natural enemies, methods and possibilities of their use in the biological control of pests. Students independently investigate the literature, prepare a written essay and present it orally.

Learning outcomes

Learning outcome	Evaluation methods
Describe biological measures to control plant pests.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Explain the main methods of biological control.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Identify the most important groups of natural enemies.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Describe the biology and ecology of the most important types of natural enemies.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Identify the most important groups of natural enemies according to their morphological features.	Work tasks during the classes, exercises and seminars, written exam.
Systematize relationships between insects with regard to their diet.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Establish the potential possibility of using natural enemies in biological control.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Define the advantages of biological control as the most environmentally friendly method of plant protection.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Compare the biological control with conventional measures of control.	Participating in the discussions, assignments during class, exercises and seminars, written exam.
Integrate newly acquired knowledge with other modules of the plant protection.	Participating in the discussions, assignments during class, exercises and seminars, written exam.

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Working methods

Teachers' obligations

Teaching according to the curriculum, monitoring the work of students, assessment and evaluation of students' work during the semester and the final exam, quality monitoring to ensure output of competence, allows contact with students.

Students' obligations

Students are required to regularly attend the classes and the attendance is recorded by the professor. For the realization of the professor's signature, students are required during the whole semester to attend at least 80% of lectures and 80% exercises and seminars. If the student is absent from school more than allowed, without reasonable cause, professor's signature will be denied and the student is required to re-enrol the subject in the next academic year. Students are required to attend training courses and seminars, where they are expected to actively engage and participate in the discussion. During the exercises the student is required to make four drawings, and during the seminar part of teaching to write and present a seminar work. The absence from two exercises during the semester is allowed. The absence from the seminar presentation is not allowed.
For acquiring the final evaluation, students take a written exam at the end of classes. For the realization of the final grade student is required to achieve the minimum points in attendance, written and oral part of the seminar, drawings and written exam. Students who do not pass the course by the end of the semester are required to take the final exam during the regular examination periods.

Methods of grading

Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
Participation and class attendance	13			16	11.7	0.39
Seminar - written	10			8	13.1	0.30
Seminar - oral	9			2	4	0.27
Drawings	8			4	4	0.18
Written exam	60				57.2	1.80
Total	100%	64-72 Sufficient (2) 73-80 Good (3) 81-90 Very good (4) 91-100 Excellent (5)		30	90	3

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Evaluation elements	Description	Deadline	Recoupment
Participation and class attendance	Grade: Minimum of 11 points is required for signature. Points achieved on attendance add up with other points. Minimum for signature is 11 points.		
Seminar - written	Grade: Minimum of 6 points is required for signature. Points achieved on written seminar add up with other points. Minimum for signature is 6 points.		
Seminar - oral	Grade: Minimum of 5 points is required for signature. Points achieved on seminar presentation add up with other points. Minimum for signature is 5 points.		
Drawings	Grade: Minimum of 6 points is required for signature. Points achieved by drawings add up with other points. Minimum for signature is 6 points.		
Written exam	Grade: Minimum of 36 points is required to pass. Points achieved by exam add up with other points. Minimum for signature is 36 points.		
Seminar - oral	At every seminar the presence of all students is recorded (at the beginning and the end). Presentations of seminar papers begin in the 8th and last until 11th week of the semester, according to the agreed schedule. All members of the working group are presenting. Presentation skills within a given time, analytic and reasoning ability, presentation appearance and teamwork are evaluated. Students are encouraged to actively debate and ask questions on topics.	8th-11th week of teaching.	The absence of a student who is presenting the seminar orally is not allowed.
Drawings	At every exercise the presence of all students is recorded (at the beginning and the end) and active participation is monitored. It is possible to justify the absence of up to two exercises / seminars during the semester, with students, regardless of the absence, required to bring all required drawings. During four hours of exercises, the student is required to keep a diary in the form of drawings or needs to do four independent tasks (two drawings of heterometabolous and two drawings of holometabolous insects). In each drawing student should	By the sixth week of teaching.	Permitted and excused absences may be justified by school doctor’s note, with the subsequent submission of the drawings.

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Evaluation elements	Description	Deadline	Recoupment
	mark the most important features and body parts of an insect.		
Written exam	The written exam consists of a number of theoretical questions. Questions include: complementing, recognition or descriptive answer. Cheating is punished in accordance with the rules of the institution and in this case the exam is cancelled.	The end of semester.	During the regular examination periods.

Weekly class schedule

1. Introduction to the module: teaching content, learning outcomes, timetable, exams. Introduction to biological control, definitions and history of biological control.
2. Explain the interspecies and intraspecies relations, the relationship of entomophagous insects to food choice.
3. Overview and division of topics for seminars and the selection of literature.
4. Explain the morphological characteristics of natural enemies from the group Heterometabola, independent work of students on recognizing entomological materials: determining the position of the head, the shape of the tentacles, type of mouthparts, type of the wings and legs under the binoculars and drawing the external structures of insects.
5. Explain the biology and ecology of the most important natural enemies from the group Heterometabola.
6. Explain the morphological characteristics of natural enemies from the group Holometabola, independent work of students on recognizing entomological materials: determining the position of the head, the shape of the tentacles, type of mouthparts, type of the wings and legs under the binoculars and drawing the external structures of insects.
7. Explain the biology and ecology of the most important natural enemies from the group Holometabola.
8. Explain the methods of reproduction, production and marketing of natural enemies.
9. Explain the biological control methods - conservative biological control method with examples and classical biological control method with examples, and conditions for their implementation.
10. Explain the augmentative biological control method and bioinsecticides, with examples and application of available living organisms.
11. Describe and explain other agents for biological control.
12. Presentation, analysis and discussion of seminar papers on a given topic.
13. Presentation, analysis and discussion of seminar papers on a given topic.
14. Presentation, analysis and discussion of seminar papers on a given topic.
15. Presentation, analysis and discussion of seminar papers on a given topic.

Obligatory literature

1. Igrc Barčić, J., Maceljski, M., (2001): Ekološki prihvatljiva zaštita bilja od štetnika, Zrinski, Čakovec
2. Teaching materials (lectures and exercises) - available on University system Merlin (moodle.srce.hr)
3. Selected chapters from the books, according to the suggestions of the Coordinator.

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Recommended literature

1. Flint, M.,L., Dreistadt, S.,H.(1998): Natural enemies handbook,Regents od the University of California,USA
2. Bellows, T.,S., Fisher, T.,W.(1992): Handbook od biological control, Academic press, California, USA
3. Ferrari, M., Marcon, E., Menta, A.(2000): Lotta biologica, Edagricole-Edizioni Agricole della Calderini, Bologna
4. Malais, M.,H., Ravensberg, W., J.(2003): Knowing and recognizing the biology of glasshouse pests and their natural enemies, Koppert, Netherlands

Similar course at related universities

- Biopesticides - Faculty of Agriculture, University of Bari „Aldo Moro“, Bari, Italy
- Insect Pest Management - College of Agriculture, Purdue University, West Lafayette, Indiana, USA
- Plant Protection - University of Hohenheim, Stuttgart, Germany
- Plant Protection Strategies and Systems - Faculty of Agricultural and Environmental Sciences, Szent István University, Gödöllő, Hungary
- Integrated Plant Protection - Faculty of Agricultural and Environmental Sciences, Szent István University, Gödöllő, Hungary
- Plant Medicine - Faculty of Agriculture, University of Bari „Aldo Moro“, Bari, Italy

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