University of Zagreb Faculty of Agriculture
Svetošimunska cesta 25, 10000 Zagreb
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Invasive pests in agriculture (296581)

Course coordinator

Assoc. Prof. Ivana Pajač Živković, PhD

Course description

The object of the course is gaining knowledge on invasive pests in agriculture. Students will learn about the effects of invasive pests on the economy, society, environment, biodiversity and human health. Also, they will be introduced to innovative methods of research of invasive pest diversity. Through laboratory exercises, students will be engaged practically with the invasive pest determination and estimation of their population size. Through group discussions students will be able to identify the causes and consequences of invasive pest occurrence in different ecological systems and to discuss available protection measures. Through the seminars, students will, based on acquired knowledge and literature search, independently investigate the issues of the present and the new, potential invasive pests.

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ECTS: **6.00**

Teaching hours: 60
Lectures: 34
Laboratory exercises: 2
Practicum: 12
Seminar: 8
Field exercises: 4

Grading

Sufficient (2): 60-70%
Good (3): 70-80%
Very good (4): 80-90%
Excellent (5): 90-100%

Lecturer

- Assoc. Prof. Ivana Pajač Živković, PhD
- Assoc. Prof. Darija Lemić, PhD
- Assoc. Prof. Maja Čačija, PhD
- Prof. Maja Šćepanović, PhD
- Assoc. Prof. Joško Kaliterna, PhD

Associate teacher for exercises

- Assoc. Prof. Ivana Pajač Živković, PhD
- Assoc. Prof. Darija Lemić, PhD
- Prof. Maja Šćepanović, PhD
- Assoc. Prof. Joško Kaliterna, PhD
- Asst. Prof. Valentina Šoštarčić, PhD

Associate teacher for seminars

- Assoc. Prof. Ivana Pajač Živković, PhD
- Assoc. Prof. Darija Lemić, PhD
- Assoc. Prof. Maja Čačija, PhD
- Asst. Prof. Valentina Šoštarčić, PhD

Type of course

- Graduate studies / Environment, agriculture and resource management (Elective course, 4 semester, 2 year)

General competencies

The course provides an understanding of the impact of invasive pests on agricultural production (economic damage and control costs), biodiversity (threats to the survival of native species and disruption of natural ecosystem functioning and balance), and human and animal health. Students will become familiar with the main representatives of the main taxonomic groups of invasive pests of Croatia, especially in terms of morphology, biology, ecology and distribution in Croatia and Europe. Special attention will be paid to monitoring methods and ways of controlling invasive pests, as well as practical identification of invasive pests based on morphological differences with simultaneous estimation of population size. Course participants will gain the necessary theoretical and practical knowledge to understand the importance of invasive pests, and the skills acquired can be successfully integrated into further education.

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Types of instruction

- Lectures
  Characterization of invasive pests in Croatia. Overview of the main representatives of the main taxonomic groups and their impact on biodiversity (threat to the survival of native species and disruption of the natural functioning and balance of the ecosystem), human and animal health and the cost of controlling invasive pests. Introduction to the process of assessing invasiveness of arthropod species, black and white lists. Routes of transmission and ways of spreading invasive pests. Overview of invasive pests in Croatia with special emphasis on morphology, biology, ecology and distribution in Croatia and Europe. New research methods for invasive pests. Special attention will be given to monitoring methods and ways of controlling invasive pests, with emphasis on integrated and environmentally sound guidelines. Consideration of factors for further spread of invasive pests under agroecological conditions of Croatia.
- Assessments
  Written examinations in the entomological, herbological and phytopathological parts of the course and final oral examination.
- Consultations
  The course coordinator and teaching assistants hold weekly office hours according to the agreed schedule, during which students receive the necessary support and guidance in adopting the subject content and preparing seminar papers.
- Laboratory practice/exercises
  Identification of invasive plant pathogens using standard identification keys.
- Practicum
  Identification of invasive arthropods and weeds using standard identification keys.
- Field work
  Collect invasive arthropods using various trap types, conduct plant organ inspections for invasive pest infestations, and determine control measures. Introduction to invasive weed species - morphological and biological characteristics and dispersal pathways.
- Seminars
  Students will prepare a written seminar paper from the entomological or botanical section of the course according to the prescribed template and present the work publicly. Topics of the papers will be determined in consultation with the course coordinator and teaching assistants according to the students' personal interests in the field.

Learning outcomes

Learning outcome	Evaluation methods
To be able to identify invasive pest species on agricultural crops.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to establish the economic importance of invasive pest species in agricultural production.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to describe and explain the life cycle of invasive pests of agricultural production.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to evaluate the importance of invasive pests in relation to the biodiversity of the agro-ecological system.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to identify the causes and consequences of the introduction and spread of invasive pests in the agroecological system.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to recommend effective protection measures from invasive pests in conventional, integrated and organic farming.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to define suppression programs and evaluate the advantages and disadvantages of available measures of suppression of invasive pests.	Active participation of students in class, work assignments during class, exercises and seminars, written and oral final examination.
To be able to integrate acquired skills in further education.	Active participation of students in class, written and oral final examination.

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Working methods

Teachers' obligations

Teaching according to the curriculum. Compilation of knowledge tests and their evaluation. Conducting oral examinations and consultations. Development of teaching materials.

Students' obligations

Regular attendance and active participation in all forms of instruction. Mandatory attendance at 80% of lectures, 80% of tutorials, and 100% of seminars. Preparation and public presentation of seminar papers. Preparation for the final written and oral examinations within the prescribed examination deadlines.

Weekly class schedule

1. Introduction and definition. Examples of invasive arthropods introduction on the territory of Croatia in the past. A brief overview of the European project DAISIE (Delivering Alien Invasive Species Inventories for Europe) L; Effects of invasive arthropods on the economy, society and the environment in Europe. Influence on biodiversity, human and animal health and the suppression costs. Pathways and vectors of invasive arthropods spreading L.
2. Procedure of assessing species invasiveness - Black and White list. List of invasive arthropods that cause concern in the European Union L; Invasive arthropods of suborder Heteroptera and Homoptera. Morphology, biology and ecology. Effects on agriculture, society and the environment. Pest monitoring, suppression methods and spreading factors L.
3. Invasive arthropods of the order Coleoptera. Morphology, biology and ecology. Effects on agriculture, society and the environment. Pest monitoring, suppression methods and spreading factors L; Invasive arthropods of the order Diptera. Morphology, biology and ecology. Effects on agriculture, society and the environment. Pest monitoring, suppression methods and spreading factors L.
4. Invasive arthropods of the order Lepidoptera. Morphology, biology and ecology. Effects on agriculture, society and the environment. Pest monitoring, suppression methods and spreading factorsm L; Invasive arachnids of the order Acarina. Morphology, biology and ecology. Effects on agriculture, society and the environment. Pest monitoring, suppression methods and spreading factors L.
5. Invasive, non-agricultural, arthropod species in the Republic of Croatia. Impact on biodiversity and human and animal health. Consideration of new, potential invasive arthropods present in neighboring countries L; New methods of investigating invasive arthropods L.
6. Identification of invasive arthropods using standard determination keys E (Lab) & I.
7. Presentation of seminar papers, discussion and grading S & M.
8. Collect invasive arthropods using various types of insect traps, conduct plant organ surveys for invasive insect infestations, and determine control measures FW; Introduction to invasive weed species - morphological, biological features and methods of spread FW.
9. Definitions and terminology of invasive plant species. History of biological invasions. Impact on the ecosystem. Impact on human and domestic animal health. Socio-economic consequences of biological invasions L; Genetic diversity of invasive weed species. Importance of ecological adaptations for invasiveness of weed species. Adaptation mechanisms of allochthonous invasive weeds. Importance of polyploidy and hybridization in

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biological invasions. Ecological genetic potential of invasive weed species L.

10. Propagation of introduced allochthonous plants. Disturbance of natural diversity. Accidental and deliberate introductions. Stages of invasive processes as a prerequisite for successful biological invasions L; Risk assessments in biological invasion processes. "Screening" system for predicting the invasiveness of allochthonous species. Resistance of invasive weeds to herbicide. Influence of different control measures on the spread of invasive weed species L.
11. Invasive weed species from the family Asteraceae - morphology, biology, mode of propagation and legislation E; Invasive weed species from the family Poaceae, Malvaceae and Solanaceae - morphology, biology, mode of propagation and legislation E.
12. Invasive woody weeds - morphology, biology, mode of propagation and legislation E; Presentation of seminar papers, discussion and grading S & M.
13. Invasive plant pathogens – definition, historical overview, socio-economic and ecological impact on natural and agroecosystem L; Significance and harmfulness of invasive plant pathogenic fungi and pseudofungi from the perspective of their socio-economic and ecological impact on natural and agroecosystems. Review of the most important invasive plant pathogenic fungi and pseudofungi that are present or are expected to become present in the territory of the Republic of Croatia, with reference to their biology and epidemiology L.
14. Significance and harmfulness of invasive plant pathogenic prokaryotes, viruses and virus-like-organisms from the perspective of their socio-economic and ecological impact on natural and agroecosystems. Review of the most important invasive plant pathogenic prokaryotes, viruses and virus-like-organisms that are present or are expected to become present in the territory of the Republic of Croatia, with reference to their biology and epidemiology L; Measures of prevention and control of the spread of invasive plant pathogenic organisms according to modern standards of integrated and ecological plant protection L.
15. Introduction to modern laboratory techniques and protocols for the identification of invasive plant pathogenic organisms according to EPPO standards E (Lab).

Obligatory literature

1. Internal script and power point presentations.
2. Roques, A., Kenis, M., Lees, D., Lopez-Vaamonde, C., Rabitsch, W., Rasplus, J.-Y., Roy, D. B., 2010. Alien terrestrial arthropods of Europe. BioRisk 4(1) (Special Issue). Pensoft Publishers, Bulgaria.
3. Zavaleta, E., Hobbs, R., Mooney, H., 2001. Viewing invasive species removal in a whole-ecosystem context. Trends in Ecology & Evolution. 16 (8): 454-459.
4. Weber, E., 2003. Invasive Plant Species of the World. CABI Publishing Wallingford, (UK) pp. 548, p. 34. Global Invasive Species Database. http://www.issg.org/database/species/ecology.asp?si=188&fr=1&sts=
5. Pimentel, D. 2011. Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal and Microbe Species, Second Edition. CRC Press, Taylor & Francis Group, Florida, SAD.
6. Inderjit (Ed.): Invasive Plants: Ecological and Agricultural Aspects. Birkhäuser Verlag, Basel, Boston, Berlin, 2005.
7. Ward, M.S., Gaskin, F.J., Wilson, M.L.: Ecological Genetics of Plant Invasion: What Do We Know? 2008. Invasive Plant Science and Management. 1: 98-109.

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Recommended literature

1. Mack, R.N., Simberloff, D., Lonsdale, W.M., Evans, H., Clout, M., Bazzaz, F.A., 2000. Biotic invasions: causes, epidemiology, global consequences, and control.
2. Hulme P.E., Roy D.B., Cunha T., Larsson T. B., 2009. A pan-European Inventory of Alien Species: Rationale, Implementation and Implications for Managing Biological Invasions. In: Handbook of Alien Species in Europe. Invading Nature - Springer Series in Invasion Ecology, vol 3. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-8280-1_1
3. Radosevich, S.R., Holt, J.S., Ghersa, C.M.: Ecology of weeds and invasive plants. Relationship to agricultural and natural resource management. Wiley-Intescience, New Jersey, 2007.
4. CABI-Invasive Species Compendium (https://www.cabi.org/isc/)

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