

Detailed Course Descriptions of Horticultural Science Subjects
Offered by the Doctoral School of Agricultural and Food Sciences

Course Description

Course title / Neptun code: MATER073N Statistical Methods	Number of credits: 10
Course coordinator (name, position, academic degree): Dr. Márta Ladányi, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Anna László, PhD	
Course type: <u>compulsory</u> /elective	
Type of class: lecture/ <u>seminar</u> / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theory, case-study analyses, project-based learning	
Requirements for successful completion: project work submission	
Assessment methods applied for evaluating learning outcomes: commented evaluation of the project work	
Recommended semester: fall (first or second)	
Prerequisites (if any): <i>master level statistical knowledge</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>Based on the knowledge students have acquired in standard Biometrics and Statistics courses at the master's level, selected chapters of advanced statistics will be discussed using complex applications. We work in a computer-based environment. Statistical methods are presented in a practical manner, with numerous agricultural applications tailored specifically to the needs of PhD students, while also addressing special data management issues and proper documentation practices. Students who lack a master's-level statistical background and need to prepare for this course can register for the Biometrics course (MATER074N) to bridge the knowledge gap. They can enrol in both the "Biometrics" and "Statistical Methods" courses in the same fall semester. In this case, the courses will be taught sequentially in intensive blocks, starting with "Biometrics" and followed by "Statistical Methods".</p>	
<p>Course Topics / Semester Schedule:</p> <p>Statistical hypothesis testing, revision: data types, outliers, missing data, Type I and Type II errors, significance level, normality tests, one- and two-sample parametric tests; one-way ANOVA; skewness and kurtosis tests, data transformation, sampling, sample size and power calculation</p> <p>Experimental design, one- and two-way ANOVA, ANCOVA models, GLM, GLMM, repeated measures ANOVA, post hoc tests, graphical representation</p> <p>Linear and nonlinear uni- and multivariate regression models, regression diagnostics, confidence intervals and bands, collinearity, PCA regression, quantile regression, write-up;</p>	

Crosstabulation, ratio tests
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
Special handouts are available during the course.
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Tabachnick, B. G., Fidell, L. S. (2019, e-version 2022). Using Multivariate Statistics (7th ed.). Pearson. ISBN 9780134790541, 0134790545, e-version: ISBN-13: 9780137526543 Andy F. (2024). Discovering Statistics Using IBM SPSS Statistics (6th ed.). SAGE Publications. ISBN 1529668719, 9781529668711</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>a) Knowledge Students acquire statistical methods in an SPSS environment based on real-world research, directly supporting the analyses required for their experimental or observational research, as well as their literature review work. b) Skills Students will be able to analyse data arising from biological-chemical research in a statistically and ethically sound manner, as well as interpret, visually present, and communicate results to a scientific standard. c) Attitude Students develop the scientific rigor necessary for performing high-quality statistical analyses and for critically and insightfully reading statistical analyses in scientific journals. d) Autonomy and Responsibility Students learn to conduct data analysis independently, responsibly, honestly, and precisely.</p>

Course Description

Course title / Neptun code: Publication of scientific results in peer-reviewed journals GENBT097N	Number of credits: 10
Course coordinator (name, position, academic degree): Attila Hegedűs, DSc, professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory	
Type of class: lecture, 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): The transfer of knowledge is carried out through lectures, seminar sessions, and individual assignments. The course involves the analysis of articles published in scientific journals, the use of publication databases (Web of Science, Scopus, and Google Scholar), and the examination of scientometric case studies. Students acquire the subject matter through practical assignments and hands-on exercises.	
Requirements for successful completion: exam	
Assessment methods applied for evaluating learning outcomes: project work	
Recommended semester: autumn	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The quality of scientific work and the success of researchers are increasingly assessed on the basis of publications resulting from their research. This course introduces the leading international and national journals in horticultural science and outlines the main characteristics of scientific publications, the fundamental requirements for manuscript preparation, the ethical use of artificial intelligence platforms, the independent and anonymous peer-review process, as well as the ethical and technical aspects of scientific publishing. Special attention is given to scientometric indicators that play an increasingly important role in the evaluation of researchers and research outcomes, including the impact factor, citation counts, the Hirsch index (h-index), the g-index, and related metrics, together with their advantages and limitations.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The role of scientific communication in research</p> <p>Overview of the international and national scientific publishing system</p> <p>Leading journals and databases in agricultural sciences</p> <p>Structure of a scientific paper</p> <p>Principles of preparing a publishable manuscript</p> <p>Use of artificial intelligence platforms in scientific writing</p> <p>Literature searching and the use of reference management systems</p>	

<p>Criteria for journal selection</p> <p>Professional editing, manuscript review, and the peer-review process</p> <p>Principles of publication ethics</p> <p>Open-access publishing and predatory journals</p> <p>Scientometric indicators (Impact Factor, CiteScore, h-index, g-index, etc.)</p> <p>Citation analysis and research performance evaluation</p> <p>Researcher identifiers and profiles (ORCID, ResearcherID, Scopus Author ID)</p> <p>Increasing the visibility and impact of research outcomes</p>
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Hyland, K., & Salager-Meyer, F. (2008). Scientific writing. <i>Annual review of information science and technology</i>, 42(1), 297.</p> <p>Alkaissi, H., & McFarlane, S. I. (2023). Artificial hallucinations in ChatGPT: implications in scientific writing. <i>Cureus</i>, 15(2).</p> <p>Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. <i>Proceedings of the National Academy of Sciences</i>, 102(46), 16569-16572.</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Kacena, M. A., Plotkin, L. I., & Fehrenbacher, J. C. (2024). The use of artificial intelligence in writing scientific review articles. <i>Current Osteoporosis Reports</i>, 22(1), 115-121.</p> <p>Jirge, P. R. (2017). Preparing and publishing a scientific manuscript. <i>Journal of Human Reproductive Sciences</i>, 10(1), 3.</p> <p>Aga, S. S., & Nissar, S. (2022). Essential guide to manuscript writing for academic dummies: an editor's perspective. <i>Biochemistry Research International</i>, 2022(1), 1492058.</p>
<p>Professional Competences Developed by the Course</p> <p>Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:</p> <p style="text-align: center;">Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p><u>Knowledge</u></p> <p>Demonstrates an understanding of the fundamental principles governing the scientific publishing system.</p> <p>Demonstrates knowledge of the structure and evaluation criteria of international and national scientific journals.</p> <p>Demonstrates knowledge of the structural and formatting requirements of scientific publications.</p> <p>Demonstrates knowledge of the principal scientometric indicators used to assess research performance.</p> <p>Demonstrates knowledge of the fundamental principles of publication ethics and the requirements of scientific integrity.</p> <p><u>Skills</u></p> <p>Able to select an appropriate scientific journal for publication.</p>

Able to independently search for, retrieve, and critically evaluate scientific literature.

Able to prepare and critically assess scientific manuscripts.

Able to interpret and apply scientometric data and indicators.

Able to plan and prepare scientific publications based on research results.

Attitudes

Strives to communicate research findings in a professional and ethical manner.

Committed to maintaining scientific quality, credibility, and integrity.

Open to understanding and adopting the expectations and standards of the international scientific community.

Autonomy and Responsibility

Able to independently evaluate and utilize scientific literature and information sources.

Takes responsibility for the accuracy of data, references, and citations used in scientific publications.

Independently applies publication and research ethics principles in scientific practice.

Course Description

Ecological Principles of Agricultural Entomology / Neptun Code: NVVED090N	Number of Credits: 6
Course Coordinator: Dr. Viktor Markó, professor, DSc	
Instructor(s) Involved in Teaching the Course: –	
Course Type: Elective	
Type of class: lecture and consultation, and total number of contact hours in the semester: 14 contact hours.	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): The course content is adapted to the research areas of the participating PhD students, focusing heavily on individual work on these topics. These sections will be discussed in detail during consultations prior to the examination.	
Requirements for successful completion: Active participation in classes and consultations, and the successful acquisition of the assigned course material.	
Assessment methods applied for evaluating learning outcomes: Oral examination	
Recommended Semester: 1–3	
Prerequisites (if any): –	
<p>Course Description</p> <p>This foundation course provides PhD students with theoretical ecological and methodical knowledge necessary for conducting research in plant protection zoology. Beginning with an evolutionary approach, the curriculum examines the adaptation processes of agricultural pests and beneficial organisms. The course discusses in detail the role of environmental conditions and ecological resources in species survival, growth, and reproduction. It covers population demographic processes, as well as elementary population interactions such as competition and predator-prey relationships. Finally, extending to community ecology, the subject analyzes animal assemblages in agricultural landscapes, with a particular emphasis on the role of biodiversity in plant protection.</p>	
<p>Course Topics / Semester Schedule:</p> <ol style="list-style-type: none"> 1. Introduction: Ecological approaches, sub-disciplines, and connections with related sciences. 2. Evolutionary Foundations and Adaptation in Agroecosystems: Phenotypic plasticity, genetic polymorphism, ecotypes, as well as allopatric and sympatric speciation. 3. Ecology of Environmental Conditions: The effects of temperature, pH, and moisture on individual physiological processes. Calculation of day-degrees and pest forecasting. 4. Insecticide Resistance: Rapid adaptation to adverse environmental conditions. 	

5. Ecological Resources: The role of essential environmental factors (quantities), such as food and space, in individual survival, growth, and reproduction.
6. Individual Performance and the Ecological Niche: The combined effects of environmental conditions and resources on individual fitness, and the concepts of fundamental and realized niches.
7. Population Demographic Processes I: Static Life Tables: Fundamental population parameters, types of survivorship curves, and the application of life tables in plant protection.
8. Population Demographic Processes II: Population Dynamics and Growth Models: Reproductive rates, density-independent (exponential) and density-dependent (logistic) growth, and the mechanisms behind population outbreaks.
9. Elementary Population Interactions – Intraspecific Competition: Mechanisms of competition within the same species.
10. Elementary Population Interactions – Interspecific Competition: Interspecific competition and its modeling.
11. Predator-Prey Relationships: The ecology of predation, functional and numerical responses in pest regulation.
12. Modeling Predator-Prey Relationships.
13. Parasitism and Parasitoid-Host Interactions: Specialized demographic impacts of parasitoids and their role in population regulation.
14. Foundations of Community Ecology: Structure of animal assemblages, trophic webs, and the organization of agroecosystems.

List of the 2–5 Most Important Required Literature

- Begon, M. and Townsend, C.R., 2020. Ecology: from individuals to ecosystems. 864 pp. John Wiley & Sons. ISBN: 1119279356
- Price, P. W., Denno, R. F., Eubanks, M. D., Finke, D. L., & Huberty, I. (2011). Insect ecology: Behavior, populations and communities. 816 pp. Cambridge University Press. ISBN 9780521542609

List of the 2–5 Most Important Recommended Literature

- Molles, M.C. and Sher, A., 2021. *Ecology: Concepts and Applications*. 608 pp. McGraw-Hill Education. ISBN: 9781264360710
- Pedigo, L. P., & Rice, M. E. (2021). Entomology and pest management (7th ed.). Waveland Press, 784 pp. ISBN 9781478646730

Professional Competences Developed by the Course

By completing the course, PhD students acquire the theoretical foundations and methodology of plant protection research, which enables them to independently investigate the ecology of pest organisms and the complex population dynamics and evolutionary processes taking place in agroecosystems. The training effectively develops critical skills and helps students design autonomous ecological research projects.

Course Description

Course title / Neptun code: Active compounds of medicinal plants	Number of credits: 6
Course coordinator (name, position, academic degree): dr. Zsuzsanna Pluhár, professor, PhD habil.	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ elective	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 28 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): lecture, consultation, literature review, individual project work	
Requirements for successful completion: submission of the project work and presentation for term mark, oral exam	
Assessment methods applied for evaluating learning outcomes: After lectures and consultations, an individual project is to be executed by the students, showing the active compounds of a model species or genus chosen in a 10 pages essay submitted online and by a presentation. PhD students have also to pass an oral exam at the end of the semester.	
Recommended semester: 3rd or 4th	
Prerequisites (if any): -	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
The main aim of the course is to provide a comprehensive insight in the wide spectra of active compounds found in medicinal and aromatic plants. The program focuses on a detailed presentation of chemical structures, classification and biosynthetic pathways known for the biologically active molecules. Basic terms and research results concerning the background of chemical diversity in medicinal plants are also shown during the course. Modern methods of extraction, chromatography and identification of special compounds are also be demonstrated.	
Course Topics / Semester Schedule: 1. Occurrence and types of active compounds detectable in medicinal plants. Significance of chemical diversity. History of chemotaxonomy and its role in the classification of plants.	

2. Basic terms in chemotaxonomy. Functions of special metabolites in the plant life. Genetical, ecological, biochemical and physiological background of their biosynthesis. Classification of active substances on the basis of metabolism.
3. Review of the literature of pharmacognosy, chemotaxonomy and phytochemical analysis. Discussion on personal essays elaborated till the end of the semester. Quality control of medicinal plant drugs in laboratory. Evaluation of origin, identity and purity. Evaluation and measurements of active substances.
4. Relationship between drug production and chemical variability in the case of some industrial crops I. (Papaver, Digitalis, Valeriana, etc.)
5. Relationship between drug production and chemical variability in the case of some Apiaceae (Coriandrum, Carum, Foeniculum, Levisticum, Angelica species) and Brassicaceae (Sinapis, Brassica species) species
6. Relationship between drug production and chemical variability in the Asteraceae I. (Matricaria, Calendula, Carthamus, Solidago, Echinacea)
7. Relationship between drug production and chemical variability in the Asteraceae II. (Achillea, Tanacetum, Artemisia)
8. Relationship between drug production and chemical variability in the case of some Lamiaceae species I. (Thymus, Lavandula, Salvia, Rosmarinus)
9. Relationship between drug production and chemical variability in the case of some Lamiaceae species II. (Ocimum, Majorana, Melissa, Mentha, Origanum)
10. Relationship between drug production and chemical variability in the case of some industrial crops II. Hypericum, Ginkgo, Ginseng, Taxus, etc.
11. Isolation of active substances. Theoretical bases of laboratory analysis. Demonstration of laboratory essential oil distillation. Comparison of conventional and current methods of extraction (demonstration of Soxhlet and SFE extractions)
12. Demonstration of analytical technics: GC, TLC-densitometry, HPLC. Demonstration of spectroscopic methods: Mass Spectrometry, UV-Spectroscopy.
13. Current methods of detection and measurement of phenolics and of antioxidant compounds
14. Consultation, information on the exams

List of the 2–5 Most Important Required Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Evans, W. Ch. (2009) Trease and Evans' Pharmacognosy, WB Saunders Ltd, UK, 2009 (ISBN 978-0702029332)

Farkas Á., Papp N., Bencsik T., Horváth Gy. (2013) Digital herbarium and drug atlas University of Pécs, Hungary, 2013 (e-book:
<https://dtk.tankonyvtar.hu/xmlui/handle/123456789/3432>)

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Hoppe, B. (Ed.): Handbuch des Arznei-und Gewürzpflanzenbaues, Band 1,4,5.
Saluplanta, e.V. Bernburg (2012-2014). (ISBN 978-3935971645)

Hornok, L.: Cultivation and processing of medicinal plants, Wiley, USA, CA 1992,
(ISBN 0471923834), Hungarian Academic Press, Budapest (ISBN 9780471923831)

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

The PhD students fulfilling the course requirements will be able to

-identify and classify wide range of active compounds belonging to different medicinal plant species, and distinguish their biosynthetic pathways

-select the most appropriate laboratory techniques for extracting and analysing the active compounds and apply the basic preparatory and analytical technics of plant samples collected during the research period

-understand the most important genetic, environmental, agrotechnical and postharvest factors influencing chemical diversity and product variability in the medicinal plant production sector

-make responsible decisions about measures and treatments applied during medicinal plant production, based on the knowledge aquired about active compounds and the reasons of their variability

Course Description

Principles of Insect Anatomy / Neptun Code: NVVED088N	Number of credits: 6
Course coordinator: Dr. Viktor Markó, professor, DSc	
Instructor(s) involved in teaching the course: –	
Course Type: Elective	
Type of Class: Lecture and consultation, and total number of contact hours in the semester: 14 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g., case presentations, case-study analyses, project-based learning, other methods): The course content is adapted to the research areas of the participating PhD students, focusing heavily on individual work on these topics. These sections will be discussed in detail during consultations prior to the examination.	
Requirements for Successful Completion: Active participation in classes and consultations, and the successful acquisition of the assigned course material.	
Assessment Methods Applied for Evaluating Learning Outcomes: Oral examination	
Recommended semester: 1–3	
Prerequisites (if any): –	
<p>Course Description</p> <p>This foundation course provides a comprehensive overview of the external and internal morphology of insects, with special emphasis on pest and beneficial arthropod organisms relevant to plant protection. Students will acquire knowledge of the anatomical structure of the digestive, respiratory, circulatory, nervous, and reproductive systems of insects, as well as the specialized modifications of the integument.</p>	
<p>Course Topics / Semester Schedule:</p> <ol style="list-style-type: none"> 1. Introduction to Insect Anatomy. The evolutionary success of insects from a morphological perspective. Fundamental anatomical concepts and terminology used in agrozoological and plant protection research. 2. The Arthropod Integument. Chemical and structural differences in the cuticle of insects, spiders, and mites. 3. Morphology of the Head and Body Regions. The insect head and mouthparts. The prosoma and opisthosoma of arachnids. Anatomy of mouthparts in mites; functional morphology of chelicerae and pedipalps. 4. Locomotor Organs and Abdominal Appendages. The insect thorax and abdomen; modifications of walking legs and wings. Anatomy of walking legs in spiders and mites; spider silk glands and spinnerets. The plant protection and ecological significance of the ovipositor and spinning apparatuses. 5. Structure of the Digestive System (Alimentary Canal). Anatomical characteristics of the foregut, midgut, and hindgut in insects. The sucking stomach of spiders and the caeca of mites. The morphological background of sucking and chewing feeding mechanisms in pest and beneficial species. 	

6. The Respiratory System. The tracheal system of insects (spiracles, tracheal trunks). The book lungs of spiders and the diverse respiratory organs of mites.
7. The Circulatory and Excretory Systems. Structure of the open circulatory system and the functions of hemolymph in insects and spiders. Comparative anatomy of Malpighian tubules and coxal glands. The role of the fat body (corpus adiposum).
8. The Nervous System and Sense Organs. The ventral nerve cord of insects and the concentrated, fused nervous system of arachnids. Morphology of mechanoreceptors, chemoreceptors, and visual organs (compound eyes and ocelli).
9. The Reproductive System. Anatomy of male and female internal and external reproductive organs in insects, spiders, and mites. Structural types of ovaries and testes; morphological background of spermatophore transfer and fertilization.
10. The Endocrine System and Exocrine Glands. The role of hormone-producing organs in molting and metamorphosis (in insects and mites). Anatomy of pheromone glands and defensive glands.
11. Integrated Morphological Synthesis. Comparative internal and external anatomy of key pest and predatory insect, spider, and mite models (e.g., aphids, spider mites, predatory mites, crab spiders). Anatomical foundations of the immune system.
12. Overview of the Morphological Characteristics and Special Adaptations of Pest or Beneficial Arthropod Groups Related to the PhD Students' Research Topics, Part I.
13. Overview of the Morphological Characteristics and Special Adaptations of Pest or Beneficial Arthropod Groups Related to the PhD Students' Research Topics, Part II.
14. Discussion of Morphological/Anatomical Problems and Diagnostic Difficulties Connected to Individual Research Topics, Part III.

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Grimaldi, D. A. (Ed.). (2023). The complete insect: Anatomy, physiology, evolution, and ecology. Princeton University Press. ISBN 9780691243108
- Moussian, B. (Ed.). (2025). Insect anatomy: Structure and function. Elsevier. ISBN 9780323856195

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Gullan, P. J., & Cranston, P. S. (2014). The insects: An outline of entomology (5th ed.). Wiley. ISBN 9781118846155
- Betz, O. (Ed.). (2025). Insect ecomorphology: Linking functional insect morphology to ecology and evolution. Academic Press. ISBN 9780443185441

Professional Competences Developed by the Course:

The knowledge acquired during the course will enable PhD students to critically and contextually interpret the morphology of the studied arthropod groups, and to integrate this understanding into their own research.

Course Description

Course Title / Neptun Code: Insect Taxonomy / NVVED087N	Number of Credits: 6
Course Coordinator: Dr. Viktor Markó, professor, DSc	
Instructor(s) involved in teaching the course: –	
Course Type: Elective	
Type of Class: Lecture and consultation, and total number of contact hours in the semester: 14 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g., case presentations, case-study analyses, project-based learning, other methods): The course content is adapted to the research areas of the participating PhD students, focusing heavily on individual work on these topics. These sections will be discussed in detail during consultations prior to the examination.	
Requirements for Successful Completion: Active participation in classes and consultations, and the successful acquisition of the assigned course material.	
Assessment methods applied for evaluating learning outcomes: Oral examination	
Recommended semester: 1–3	
Prerequisites (if any): –	
<p>Course Description</p> <p>This foundation course provides PhD students conducting agrozoological research with high-level background knowledge on the evolution, phylogeny, and modern classification systems of terrestrial arthropods, with a specific focus on insects, spiders, and mites. Students will master the analysis of morphological and molecular taxonomic traits, the rules of nomenclature, and the use of complex identification keys. Successful completion of the course enables doctoral students to establish a sound taxonomic basis for their entomological and arachnological research and to place it within a broader context.</p>	
<p>Course Topics / Semester Schedule:</p> <ol style="list-style-type: none"> 1. Introduction to Modern Taxonomy: History, basic concepts, and current research trends in arthropod systematics. 2. Character Analysis and Molecular Taxonomy: Integrative taxonomy, DNA barcoding, and the role of genomics in classification. 3. Phylogenetic Reconstruction and Nomenclature: Cladistic methods and the rules of the International Commission on Zoological Nomenclature (ICZN). 4. Zoological Collections and Type Specimens: Museological methods, the scientific status of holotypes and paratypes, collection management, and digital taxonomy. 5. Subphylum Chelicerata and Systematics of Araneae (Spiders): Early diversification of chelicerates, phylogeny of spiders, and diagnostic characters of major families. 	

<ol style="list-style-type: none"> 6. Diversity and Systematics of Acari (Mites): Taxonomy of groups with agricultural and plant protection significance. 7. Hexapod Evolution, Palaeoptera and Polyneoptera Lineages: Entognatha and Apterygota groups, early winged insects, with a stronger emphasis on the complex evolution of orthopteroid orders. 8. Paraneoptera Phylogeny: Morphology, diversity, and modern systematics of hemipteroid insects (Hemiptera, Thysanoptera, Psocodea). 9. Holometabolous Radiation and Coleoptera: The evolutionary success of complete metamorphosis, the morphological background of beetle megadiversity, and Coleoptera taxonomy. 10. Hymenoptera Systematics: Evolution of hymenopterans, the morphological expression of the parasitoid lifestyle, and sociality. 11. Antliophora and Amphiesmenoptera: Evolution and modern classification of flies (Diptera), butterflies and moths (Lepidoptera), and caddisflies (Trichoptera). 12. Taxonomic Questions Related to the Course: Students' Research Topics 1 13. Taxonomic Questions Related to the Course: Students' Research Topics 2 14. Taxonomic Questions Related to the Course: Students' Research Topics
<p>List of the 2–5 Most Important Required Literature</p> <ul style="list-style-type: none"> • Hickman, C. P., Jr., Keen, S. L., Eisenhour, D. J., Larson, A., & I'Anson, H. (2023). <i>Integrated principles of zoology</i> (19th ed.). McGraw-Hill Education. (Chapter 10). ISBN 1266263292. • McGavin, G. C., Davranoglou, L. R., & Lewington, R. (2023). <i>Essential entomology</i>. Oxford University Press. ISBN 978-0-19-284311-1
<p>List of the 2–5 Most Important Recommended Literature</p> <ul style="list-style-type: none"> • Footitt, R. G., & Adler, P. H. (Eds.). (2017–2018). <i>Insect biodiversity: Science and society</i> (2nd ed., Vols. 1–2). Wiley. ISBN: 978-1-118-94553-7 (Vol. 1), ISBN 978-1-118-94557-5 (Vol. 2). • Brusca, R. C., Giribet, G., & Moore, W. (2023). <i>Invertebrates</i> (4th ed.). Oxford University Press. ISBN 978-0-19-755441-8
<p>Professional Competences Developed by the Course</p> <p>By mastering the course material, students will acquire the taxonomic knowledge, systemic approach, and integrative phylogenetic understanding necessary to conduct arthropod research. Additionally, doctoral students will familiarize themselves with the precise application of the ICZN nomenclatural code and develop the capacity to critically evaluate modern classification systems.</p>

Course Description

Course title / Neptun code: Environmental and Functional Microbiology of Horticultural Systems / ELTUD523N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Kocsis Tamás József, Associate Professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/elective elective	
Type of class: lecture and consultation, and total number of contact hours in the semester: 20 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Knowledge is delivered through lectures and project work.	
Requirements for successful completion: Practical grade	
Assessment methods applied for evaluating learning outcomes: Assessment based on the project work using a five-point grading scale.	
Recommended semester: Not tied to a specific semester.	
Prerequisites (if any):	
<p>Course Description</p> <p>The aim of the course is to provide a comprehensive overview of microbial communities in horticultural systems, with particular emphasis on their ecological roles and functional significance. Students will gain an understanding of microbial responses to environmental factors, including climatic conditions, abiotic stresses, and pollutants, as well as the role of microbiome diversity in maintaining the stability of agroecosystems and the potential of biological approaches in sustainable horticultural practices. Particular emphasis is placed on the functional interactions of endophytic, rhizospheric, and epiphytic microorganisms with plants.</p>	
<p>Course Topics / Semester Schedule:</p> <ul style="list-style-type: none"> • Microbial communities and diversity in horticultural agroecosystems • Characteristics and functions of soil, rhizosphere, endophytic, and epiphytic microbiomes • Plant–microbe interactions and the role of microbial communities in plant development • Adaptation of microbial communities to environmental stressors • Effects of climatic and abiotic stresses on plant–microbe systems 	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	

<ul style="list-style-type: none"> • Yadav, A. N., Singh, J., Rastegari, A. A., & Yadav, N. (eds.) (2020): Plant Microbiomes for Sustainable Agriculture. Springer, Cham. 1st ed., XXIII + 482 p. ISBN 978-3-030-38452-4 (hardcover); ISBN 978-3-030-38453-1 (eBook). • Mathur, P., & Roy, S. (eds.) (2025): Plant Microbiome and Biological Control: Emerging Trends and Applications. Springer, Cham. 1st ed., XXVI + 624 p. ISBN 978-3-031-75844-7 (hardcover); ISBN 978-3-031-75845-4 (eBook).
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<ul style="list-style-type: none"> • Sharma, S. K., Singh, U. B., Sahu, P. K., Singh, H. V., & Sharma, P. K. (eds.) (2020): <i>Rhizosphere Microbes: Soil and Plant Functions</i>. Springer, Singapore. 1st ed., XX + 682 p. ISBN 978-981-15-9153-2 (hardcover); ISBN 978-981-15-9154-9 (eBook). • Egamberdieva, D., & Ahmad, P. (eds.) (2018): <i>Plant Microbiome: Stress Response</i>. Springer, Singapore, 1st ed., XII + 384 p. ISBN 978-981-10-5513-3 (eBook).
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>Knowledge</p> <ul style="list-style-type: none"> • Comprehensive knowledge of the microbial communities, diversity, and functional roles in horticultural agroecosystems. • Knowledge of the relationships between microbiome diversity, agroecosystem stability, and plant stress tolerance. <p>Skills</p> <ul style="list-style-type: none"> • Ability to critically evaluate and synthesize scientific information on microbial communities in horticultural agroecosystems. • Ability to scientifically evaluate the applicability and limitations of microbe-based solutions. <p>Attitude</p> <ul style="list-style-type: none"> • Critically and systemically evaluates the interactions between plants, microorganisms, and the environment. • Strives to evaluate scientific findings in a well-founded, objective, and evidence-based manner.

Course Description

Course title / Neptun code: Environmental control in vegetable production/ KERTU124N	Number of credits: 6
Course coordinator (name, position, academic degree): Noémi Kappel Phd full professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 2 lecture/26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Description of environmental factors influencing the cultivation of vegetable crops, their practical impact, and possibilities for their regulation. A student's submission on a summary of the environmental factors influencing the cultivation of the test crop used in her/his doctoral research.	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: preparation of the assignment and oral exam	
Recommended semester: 3-4	
Prerequisites (if any):	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
The needs of vegetable production: heat, water, nutrient, soil. Fundamental and practical basis of environmental control in vegetable production systems, financial and technical opportunities. We will discuss the soil tillage, irrigation, fertilization, nutrient supply, heating, cooling, CO ₂ addition influence onto vegetable species. The subject focus onto the abiotic disorders their symptoms and resolving. The intensive and integrated vegetable growing technologies also demonstrated.	
Course Topics / Semester Schedule: Environmental requirements of vegetable plants (heat and light) Environmental requirements of vegetable plants (water, soil, nutrients) Developmental disorders and their control (climatic, nutrients)	
List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.	

Donald N. Maynard and George J. Hochmuth (2007): Knott's Handbook for vegetable growers. John Wiley and Sons, Inc. ISBN: 978-0-471-73828-2

Salunkhe, D. K., Kadam, S.S. 1998. Handbook of Vegetable Science and Technology: Production, Composition, Storage, and Processing Food Science and Technology. CRC Press. 721 p.

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Rubatzky, V.E., Yamaguchi, M. (ed.) 1997. World Vegetables. Principles, Production and Nutritive Values. Chapman & Hall. 843 p.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

The course introduces the general ecological conditions necessary for the cultivation of vegetable plants, their effects and regulatory options. By completing the course, the student will learn the basic principles of vegetable production on crop farms, both for open-field and greenhouse farming.

Course Description

Course title / Neptun code: Genetic bases and breeding of medicinal and aromatic plants	Number of credits: 6
Course coordinator (name, position, academic degree): Éva Zámbooriné Németh, full professor, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: ..13/13=26..... contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): lectures, examples form practice, discussion, consultation, evaluation of scientific articles, preparation of assay work and presentation	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: presentation, discussion (1-5 scale)	
Recommended semester: 3-4	
Prerequisites (if any): <i>no</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>In th eframe of the course student will be acquainted with the significance of biological bases in medicinal plant production and drug quality. It presents the up-to date goals and tendencies of MAP breeding together with practical difficulties. Role of genotype and breeding method in quality assurance of MAPs. Results from the most famous projects of this topic and those of the department.</p>	
<p>Course Topics / Semester Schedule:</p> <p>genetic diversity pof medicinal and aromatic plants, breeding methods, examples and results, goals of research and breeding, significance of biotechnology in his sector</p>	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	
<p>Material of the lectures</p> <p>Zámbooriné Németh, É. (2013): Breeding and application of varieties in medicinal plant production, In: Éva Németh Zámbooriné, Szilvia Sárosi, Levente Horváth: Modern Horticulture. Corvinus University of Budapest, Faculty of Horticultural Science, 2013. (ISBN: 978-963-503-552-6)</p>	
List of the 2–5 Most Important Recommended Literature	

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Patonay, K., Szalontai, H., Radácsi, P., Zámboiné Németh É. (2021): Chemotypes and their stability in *Mentha longifolia* L. – A comprehensive study of five accessions, *Plants*, 10, 2478.

Németh, É. (2001): Goals and results in improvement of biological background of medicinal plant production, *Internat. J. of Horticult. Sci.* 7, (2), 20-27.

Singh, R.J. (ed.): Genetic resources, chromosome engineering and crop improvement, Vol. 6. Medicinal Plants. CRC Press, Boca Raton, 353-392.

Németh, É. (2005): Production and breeding of medicinal plants. In: Yaniv, Z. – Bachrach, U.(ed.): Handbook of medicinal plants, The Haworth press, Inc. Binghamton,. Chapter 10. p. 193-212.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

He/she is aware of the strategic role of R+D+I at the target area of horticulture, of its elements and interactions, connections in order to produce stable quality of MAP drugs.

Posses knowledge on the necessary specific research methods, abstraction technics, methods of elaborating practical solutions based on theoretical facts..

He/she is able to identify professional problems, planning, realising and leading projects in the specific topic as well as introducing the results into the practice.

Course Description

Course title / Neptun code: Introduction of medicinal and aromatic plants into the agriculture	Number of credits: 6
Course coordinator (name, position, academic degree): Éva Zámboziné Németh, full professor, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):-	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: ...13/13=.26..... contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): lectures, examples from practice, discussion, consultation, evaluation of scientific articles, preparation of a sample project and presentation	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: presentation, discussion (1-5 scale)	
Recommended semester: 3-4	
Prerequisites (if any): <i>no</i>	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
The course is focusing on that tendency which is important worldwide, that providing stable quantity and quality of medicinal drugs is not really possible from wild habitats. Shows the way of a sustainable solution by cultivation or semi-cultivation.	
Course Topics / Semester Schedule: Background of the need of introduction of medicinal and aromatic plants into the agriculture Task to solve and necessary developments during the process Successful examples from all over the world	
List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.	
Materials of the lectures Nguyen Thi Huong: Biological bases of the cultivation of <i>Artemisia absinthium</i> / wormwood	

PhD Thesis, SZIU 2018
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Németh, É. (2000): Needs, problems and achievements of introduction of wild growing medicinal plants into the agriculture, Proc. of the First Conference on Medicinal and Aromatic Plants of Southeast European Countries, May 29-June 3, Arandelovac, Yugoslavia, p. 1-10. Zámboiné Németh É., Rajhárt P., Seidler-Łożykowska, K. Pluhár, Zs., Szabó K. (2019): Intraspecific responses of medicinal plants: Genotype-environment interaction may alter drug quality of aromatic plants Biochem. Syst. and Ecol. Vol. 86, https://doi.org/10.1016/j.bse.2019.103914</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>He/she is aware of the strategic role of R+D+I at the target area of horticulture, of its elements and interactions, connections in order to produce stable quality of MAP drugs. Possess knowledge on the necessary specific research methods, abstraction technics, methods of elaborating practical solutions based on theoretical facts.. He/she is able to identify professional problems, planning, realising and leading projects in the specific topic as well as introducing the results into the practice.</p>

Course Description

Course title / Neptun code: Light-, fluorescent and confocal microscopy / KORTU265N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Kata Jäger, Senior Research Associate, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: weekly 2 lecture class / 1 practical class contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Case presentations, guided laboratory practices	
Requirements for successful completion: attending 80% of classes or labs and passing the oral exam	
Assessment methods applied for evaluating learning outcomes: oral exam	
Recommended semester 2-4	
Prerequisites (if any):	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>This course helps students select the most suitable microscope type and technique for cell and histological examinations to solve specific scientific problems. It presents the history of microscopy and the development of modern techniques. It introduces basic optical concepts, microscope structures, special illumination methods, and microscopic procedures. It describes biological sample preparation, histological embedding, sectioning, and histochemical staining methods. Finally, it provides insight into evaluating observed or recorded images and introduces image-analysis methods.</p>	
<p>Course Topics / Semester Schedule:</p> <ol style="list-style-type: none"> 1. Introduction, history of microscopy 2. Microtechnique I.: sample collection, fixation and embedding 3. Microtechnique II.: sectioning, staining/labelling procedures 4. Fundamentals of geometric optics 5. Fundamentals of wave optics 6. Basics of light microscopy, contrast enhancement procedures 7. Compound microscope parts and function I. 8. Compound microscope parts and function II. 9. Fluorescence microscopy I.: fundamentals 	

10. Fluorescence microscopy II .: application
11. Confocal laser scanning microscopy (CLSM) and super-resolution microscopy (SRM)
12. Image processing and quantitative analysis

List of the 2–5 Most Important Required Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Anderson J. (2026) Essentials of Light Microscopy. Oxford University Press, pp. 256, ISBN: 9780192896520

Ruzin S.E. (1999) Plant Microtechnique and Microscopy. Oxford University Press, pp. 322, ISBN: ISBN : 0195089561

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Nechyporuk-Zloy (ed.; 2022) Principles of Light Microscopy: From Basic to Advanced. Springer, pp. 324, ISBN: 9783031044762

Yeung C.T.Y, Stasolla C., Sumner M.J., Huang B.Q. (eds; 2015) Plant Microtechniques and Protocols, Springer, pp. 576, ISBN: 9783319359359

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Autonomy and Responsibility

Course Description

Course title / Neptun code: Propagation biology, Developments of Plant Propagation Technology / TETTD247N	Number of credits: 8
Course coordinator (name, position, academic degree): Károly Hrotkó, Professor Emeritus, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: <u>lecture/seminar</u> / practical / consultation, and total number of contact hours in the semester: ...39.... contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Lectures, case presentations, preparation of a review paper on a topic related to the course content, approved by the course coordinator, with a minimum length of 10 pages and based on at least 30 scientific literature sources. Presentation of students on the review paper topic in the frame of seminars.	
Requirements for successful completion: colloquium	
Assessment methods applied for evaluating learning outcomes: Students may obtain a recommended grade based on their individual coursework; alternatively, the course may be completed by passing an oral examination (colloquium) during the examination period.	
Recommended semester: free elective	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The aim of the course is to provide students with comprehensive knowledge of current national and international research trends in plant propagation biology and technology development. Overview of the recent development in propagation biology and technology of woody plants with special emphasis on: seed biology, seed production systems; variability of clonal plant material, maintenance of healthy and true-to-type clonal propagating material; endogen factors and environmental control of adventitious root formation; physiology of graft union formation, biology of interactions of graft components, rootstock usage in woody plant cultivation.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Presentation and discussion of course curriculum. History of development in woody plant propagation.</p> <p>Seed biology, genetic basis of seed production systems. Hormonal and environmental control of seed germination.</p> <p>Role of clonal plant material in horticultural practice. Genetic and anatomical background of variability in clonal plant material. Biological basis of maintenance of healthy and true-to-type clonal propagating material.</p>	

Adventive root formation: anatomy, biology, and hormonal control, usage of bioregulators. Environmental physiology factors of adventitious root formation. Biology, genetics and technology problem in integration of micropropagation into propagation technology of woody plants. Grafting in horticultural practice, anatomy and biology of graft union formation. Physiology of rootstock/scion interactions, graft incompatibility. Methodology of rootstock research and evaluation, rootstocks of fruit and ornamental trees. Complex development of propagation technology by integration the recent achievements of biology.

List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

PPT files of lectures (see on the homepage of the department: <https://landscape.uni-mate.hu/floriculture>) – login is needed!

Hrotkó K. 1999. A fás növények szaporításbiológiája (Propagation biology of woody plants). in Hrotkó K. Gyümölcsfaiskola. 7 – 104.pp, Mezőgazda Kiadó, ISBN 963 9239 30 5

List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Hartmann, H.T., Kester, D.E., Davies, F.T. és Geneve, R.L. Plant propagation. Prentice-Hall, Inc. 2011.

Hrotkó, K. & Erdős, Z. 2008. Floral biology of tree fruit rootstocks. In Nyéki, Soltész & Szabó: Morphology, Biology and Fertility of Flowers in Temperate Zone Fruits. Akadémiai Kiadó, Budapest. 377-392.

Benech-Arnold, R. L. and Sánchez, R. A. Handbook of Seed Physiology. Haworth Press. 2004.

Jámborné Benczúr, E. és Dobránszki J. 2005. Kertészeti Növények mikroszaporítása. Mezőgazda Kiadó, Budapest.

Hrotkó, K. 2013. Development in Fruit Trees Production Systems. AgroLife, Scientific Journal. 2(1). 28-36. UASVM, Bucharest, ISSN 2285-5718.

Professional Competences Developed by the Course
Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:
Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge

- Demonstrates comprehensive knowledge of current national and international trends in woody plant propagation.
- Advanced understanding of modern propagation technologies used in the major woody plant crops.
- Comprehensive knowledge of the current objectives, methods, and achievements of development and research of woody plant culture.

Skills

- Ability to critical analyse and comparative evaluation of the international scientific literature in the field.
- Ability to independent analyses of the scientific background in propagation technologies.
- Ability to synthesize research findings and prepare scientific review papers.

Attitude

- Is open to adopting new propagation technologies and advances in woody plant culture.
- Is committed to evidence-based scientific decision-making.
- Recognises the importance of innovation, sustainability, and environmental considerations in woody plant propagation and rootstock usage.

Autonomy and Responsibility

- Ability to independently identify, process, and critically evaluate scientific literature.
- Participates responsibly in the planning and evaluation of research activities.
- Bases scientific conclusions on reliable scientific evidence and ability to critical interpretation of published research findings.

Course Description

Course title / Neptun code: Results and application of Molecular Biology in Horticulture; NOVTR176N	Number of credits: 8
Course coordinator (name, position, academic degree): Dr István Papp, professor, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. István Papp (professor, DSc), Dr. Attila Hegedűs (professor, DSc), Dr. Júlia Halász (professor, DSc), Dr. Zsuzsanna György (professor, PhD), Dr Adrienn Kerekes (assistant professor, PhD), Dr. Erzsébet Kissné Bába (assistant professor, PhD), Dr. Anita Szegő (associate professor, PhD)	
Course type: <u>compulsory</u> /elective	
Type of class: <u>lecture</u> /seminar / <u>practical</u> / consultation, and total number of contact hours in the semester: 26+13 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): lectures and laboratory training	
Requirements for successful completion: successful completion of a test in practical training followed by examination	
Assessment methods applied for evaluating learning outcomes: test on practical training and written examination	
Recommended semester: spring (3-4 th)	
Prerequisites (if any): <i>none</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>The course deals with the most important techniques, achievements and practical applications of plant molecular biology in Horticulture. During the course students gain theoretical and practical knowledge about the topics covered. They acquire insight into some aspects of current efforts of systems biology, breeding, biotechnology of Horticultural plants and advanced cultivation practices used commercially in this area. This will be provided from a molecular biological perspective touching on relevant subjects in basic science as well.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Relevant parts of plant molecular genetics, biochemistry and physiology are covered in order to refresh, update and extend pre-existing knowledge about the topics of the course. Modern molecular methods of nucleic acids and protein research are detailed. Biotechnological applications purposefully manipulating metabolic fluxes (metabolic engineering) physiological processes and/or the genetic material of plants in order to improve yield or product value in Horticulture are covered within this course. In the lectures state of the art methods of molecular markers, bioinformatics and gene technology are introduced. Genetically modified plants and their properties, including</p>	

risks and environmental concerns as well as techniques for marker assisted breeding will also be dealt with. Other main areas of the course include current achievements of fruit biology, water relations of horticultural plants and the use of plant growth regulators for crop improvement. Practical education during the course will give hands-on experience about selected parts of the theoretical topics, e.g. protein research, basic procedures of gene technology, analysis of genetic markers, bioinformatics.

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Plant Development and Biotechnology 2000; Trigiano and Gray, CRC Press

Biochemistry and Molecular Biology of Plants 2nd ed. 2015; Eds, Buchanan et al, ASPB

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Plant Biotechnology and Agriculture 2012 Eds Altman and Hasegawa, Academic Press

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Upon completion of the program students are able to understand and evaluate current achievements of modern plant biology in Horticulture. With these advanced skills and knowledge they can make more reliable autonomous decisions in various fields of Horticultural practice.

Course Description

Course title / Neptun code: The role of the terroir in viticulture / SZBOR106N	Number of credits: 6
Course coordinator (name, position, academic degree): Péter Bodor-Pesti , associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ elective	
Type of class: lecture /seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Throughout the semester, lectures will cover the terroir characteristics that influence viticulture as well as the quantity and quality of the fruit. To get a detailed understanding of these topics, students will be introduced to Hungarian and international scientific publications and terroir classification systems.	
Requirements for successful completion: written exam	
Assessment methods applied for evaluating learning outcomes: 1 to 5 grade	
Recommended semester 1-4	
Prerequisites (if any):	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
This course examines the environmental factors that shape the unique character of vineyard terroirs, such as physiographic, climatic, and edaphic characteristics. We discuss in detail the methods for classifying terroirs, their historical background, current regulations, and future possibilities. We define the concept and significance of terroir through scientific articles. We present remote sensing methods suitable for describing vineyard characteristics.	
Course Topics / Semester Schedule: The Concept of Terroir Factors Influencing the Formation of Terroir Edaphic Factors Climatic Factors Physiographic Factors Classification System for Wine-Growing Regions Cadastral Classification of Wine-Growing Regions Remote Sensing Methods for Characterizing Wine-Growing Regions	
List of the 2–5 Most Important Required Literature	

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Matthews, M. A. (2016). Terroir and other myths of winegrowing. Univ of California Press. 328. ISBN: 9780520276956

Bisztray Gy. D, és Bodor, P. (2015): Hungarian grape varieties and wine terroirs. 83.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge:

The student has comprehensive knowledge of the edaphic, climatic and physiographic factors determining the individual characteristics of vineyard sites, their interactions, and the concept and significance of terroir. The student understands the basic principles of vineyard site classification and evaluation systems, as well as remote sensing methods applicable to the characterization of vineyard sites.

Skills:

The student is able to evaluate and compare environmental factors determining vineyard sites, interpret different site classification systems, and critically analyze scientific publications. The student is able to identify relationships between site conditions, viticultural performance, and the quantitative and qualitative characteristics of grape production.

Attitude:

The student is open to the complex and multidisciplinary evaluation of vineyard sites and to the application of scientific results and innovative technological methods. The student is committed to the sustainable and professionally sound use of vineyard site resources.

Autonomy and Responsibility:

The student is able to independently process scientific literature, evaluate vineyard site characteristics, and formulate professional conclusions. The student takes responsibility for scientifically grounded professional decisions that consider the specific characteristics of vineyard sites.

Course Description

Course title / Neptun code: Bioinformatics in research of protein evolution GENBT107N	Number of credits: 6
Course coordinator (name, position, academic degree): Attila Hegedűs, DSc, professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: elective	
Type of class: lecture: 26 contact hours	
<p>Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods):</p> <p>Knowledge transfer is delivered through a combination of lectures and computer-based practical sessions. The course integrates the use of publicly accessible biological databases and established bioinformatics software tools to provide both theoretical foundations and practical competencies in contemporary bioinformatics. Through the analysis of gene and protein sequence data, students acquire a comprehensive understanding of the fundamental methodologies of sequence alignment, homology detection, phylogenetic inference, and protein structure prediction. The acquisition of knowledge and skills is further supported by case-study analyses, independent data-processing exercises, and the critical evaluation of relevant scientific literature, thereby fostering analytical thinking and the application of bioinformatics approaches to biological research problems.</p>	
Requirements for successful completion: exam	
Assessment methods applied for evaluating learning outcomes: oral exam	
Recommended semester: 3-4	
Prerequisites (if any): <i>genetics</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>Bioinformatics is an indispensable tool in modern genetic and genomic research. This course introduces the databases, software platforms, and analytical tools required for contemporary molecular biology studies. Particular emphasis is placed on the analysis of plant gene and genome sequences and the extraction of biologically relevant information using bioinformatics approaches. Through selected case studies, students explore molecular evolutionary processes and the genetic basis of agriculturally important traits in cultivated plant species. The course combines theoretical foundations with practical applications to develop competencies in biological data analysis and interpretation.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The role of bioinformatics in modern plant science</p> <p>Biological databases and their applications</p> <p>Management and analysis of gene and protein sequences</p> <p>Concepts of homology, orthology, and paralogy</p>	

Sequence alignment methods (BLAST, pairwise and multiple sequence alignments)
Identification of conserved domains and sequence motifs
Evolutionary analysis of protein families
Fundamentals of phylogenetic analysis
Protein structure prediction and functional annotation
Molecular basis of plant adaptation and domestication
Bioinformatic investigation of the evolutionary basis of agriculturally important traits
Application of bioinformatics tools in plant breeding research and crop improvement programs

List of the 2–5 Most Important Required Literature
(textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Patthy, L. (2009). *Protein evolution*. John Wiley & Sons.

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Rosenberg, M. S. (Ed.). (2009). *Sequence alignment: methods, models, concepts, and strategies*. Univ of California Press.
Baxevanis, A. D., Bader, G. D., & Wishart, D. S. (Eds.). (2020). *Bioinformatics*. John Wiley & Sons.

Professional Competences Developed by the Course
Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:
Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge

Demonstrates an understanding of the fundamental methods and applications of bioinformatics.
Demonstrates knowledge of the structure, content, and use of major biological databases.
Demonstrates knowledge of the theoretical foundations of protein evolution studies.
Demonstrates knowledge of the principal methods used in sequence comparison, phylogenetic analysis, and protein structure prediction.
Demonstrates knowledge of the major patterns of evolutionary diversity in plant genomes and protein families.

Skills

Able to perform bioinformatic analyses of plant gene and protein sequences.
Able to independently retrieve, process, and interpret data from publicly available biological databases.
Able to identify homologous proteins and conduct comparative sequence analyses.
Able to perform phylogenetic analyses and interpret their results.
Able to investigate relationships between molecular evolutionary processes and agriculturally important plant traits.

Attitudes

Open to the application of bioinformatics methodologies in biological research.

Strives for the critical and scientifically rigorous interpretation of biological data.
Demonstrates an interest in molecular evolution and applied plant genetics research.
Committed to reproducible, transparent, and ethical data analysis practices.

Autonomy and Responsibility

Able to independently conduct bioinformatic data acquisition and analysis.
Takes responsibility for the appropriate use of data sources and analytical methods.
Able to formulate independent scientific conclusions based on the results of bioinformatic investigations.
Able to integrate bioinformatics and molecular biology knowledge in the design and execution of research projects.

Course Description

Course title / Neptun code: MATER074N Biometrics	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Márta Ladányi, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Anna László, PhD	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/ <u>seminar</u> / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theory, case-study analyses, project-based learning	
Requirements for successful completion: project work submission	
Assessment methods applied for evaluating learning outcomes: commented evaluation of the project work	
Recommended semester: fall (first or second)	
Prerequisites (if any): <i>no</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The course ‘Statistical Methods’ (MATER073N) for doctoral students is at advanced level building on a master level prior knowledge. For those who feel the need to prepare for this course, an intensive, optional course is a good choice. Biometrics (MATER074N) helps the students to fill the gap between level differences.</p> <p>During the semester, the content of the master-level courses in Statistics and Biometrics will be presented in an intensive way. We work on computer-based exercises, learn many examples in a practical way, adapted to the needs of PhD students. The use of the IBM SPSS Statistics (v.31) statistical software will be taught from the basics.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Representative statistical random sample; data types, data management; Estimations of the expected value and variance; descriptive statistics Statistical hypothesis testing; null hypothesis, alternative hypothesis Type I and Type II errors, significance level Nonparametric test: normality tests (Chi-square test; Kolmogorov-Smirnov’s test; Shapiro-Wilk’s test, d’Agostino’s test), PPlot, data transformation for normality; Confidence intervals for the expected values and variance of a normally distributed population Nonparametric test: Chi-square test of independence One-and two-sample parametric tests of variance: Chi-square test, Fisher’s test; one-and two-sample parametric tests of expected value: Student’s t test, Welch’s test; paired t test Bartlett’s test; Levene’s test; One-way analysis of variance; two-way analysis of variance; interaction, post hoc tests; write-up</p>	

Correlation; Linear regression model, univariate, multivariate model Regression diagnostics, write-up;
List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.
Special handouts are available during the course.
List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.
Tabachnick, B. G., Fidell, L. S. (2019, e-version 2022). Using Multivariate Statistics (7th ed.). Pearson. ISBN 9780134790541, 0134790545, e-version: ISBN-13: 9780137526543 Field, Andy P. (2024). Discovering Statistics Using IBM SPSS Statistics. SAGE Publications. ISBN 1529668719, 9781529668711
Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility
<p>a) Knowledge Students acquire basic statistical methods in an SPSS environment based on real-world research, directly supporting the analyses required for their experimental or observational research, as well as their literature review work.</p> <p>b) Skills Students will be able to analyse simple data arising from biological-chemical research in a statistically and ethically sound manner, as well as interpret, visually present, and communicate results to a scientific standard.</p> <p>c) Attitude Students develop the scientific rigor necessary for performing statistical analyses and for critically and insightfully reading statistical analyses in scientific journals.</p> <p>d) Autonomy and Responsibility Students learn to conduct basic data analysis independently, responsibly, honestly, and precisely.</p>

Course Description

Course title / Neptun code: Genetic Determinants of Economically Important Traits in Horticultural Crops	Number of credits: 6
Course coordinator (name, position, academic degree): Júlia Halász, Professor, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: elective	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Knowledge transfer is provided through lectures. Presentations, scientific literature, and digital educational materials are used during instruction. The learning process is supported by the use of digital databases and discipline-specific software.	
Requirements for successful completion: exam	
Assessment methods applied for evaluating learning outcomes: Oral exam	
Recommended semester 3rd-4th semester	
Prerequisites (if any): Basic knowledge of genetics	
<p>Course Description</p> <p>Today, the genome sequences of numerous vegetable and fruit crop species are available. Beneficial changes, such as increased fruit size, altered plant architecture, or modified reproductive characteristics, as well as detrimental traits, including the lack of resistance to diseases and pests, can be identified and interpreted through genomic information. The course presents concrete examples demonstrating how different types and magnitudes of genomic variation have led to the differences observed between wild and cultivated forms of the same species. It also explains how this wealth of molecular information can be utilized effectively in modern plant breeding programs.</p>	
<p>Course Topics / Semester Schedule: ☐ Genetic basis of plant domestication</p> <p>The role of genomic research in the study of horticultural crops</p> <p>Genetic determinants of economically important traits</p> <p>Genetic background of fruit size and fruit quality</p> <p>Genetic regulation of growth habit and phenological traits</p> <p>Genetics of flowering, self-incompatibility, and reproductive traits</p> <p>Genetic basis of disease and pest resistance</p> <p>Genetic background of abiotic stress tolerance</p> <p>Comparative genomics of wild and cultivated genotypes</p>	
List of the 2–5 Most Important Required Literature	

Shahrajabian, M. H., Sun, W., & Cheng, Q. (2021). *Molecular breeding and the impacts of some important genes families on agronomic traits, a review*. Genetic Resources and Crop Evolution, 68(5), 1709–1730.

Ingvarsson, P. K., & Street, N. R. (2011). *Association genetics of complex traits in plants*. New Phytologist, 189(4), 909–922.

Kashyap, A., Garg, P., Tanwar, K., Sharma, J., Gupta, N. C., Ha, P. T. T., & Rao, M. (2022). *Strategies for utilization of crop wild relatives in plant breeding programs*. Theoretical and Applied Genetics, 135(12), 4151–4167

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

List of the 2–5 Most Important Recommended Literature

Burdon, R. D., Dvorak, W. S., King, J. N., Kondo, T., & Krakowski, J. (2011). *Economic importance, breeding objectives and achievements*. In: *Genetics, Genomics and Breeding of Conifers*, p. 40.

Begna, T. (2021). *Role and economic importance of crop genetic diversity in food security*. International Journal of Agricultural Science and Food Technology.

Professional Competences Developed by the Course

Knowledge

- Knowledge of the genetic determinants of economically important traits in horticultural crops.
- Understanding of the main types of genetic changes arising during domestication, selection, and breeding.
- Knowledge of genes and genetic processes influencing productivity, fruit quality, resistance, and stress tolerance.

Skills

- Ability to interpret the genetic background of economically important traits.
- Ability to independently process scientific literature and synthesize acquired knowledge.

Attitudes

- Openness toward the application of genomic research and modern genetic discoveries in plant breeding.
- Commitment to scientifically sound, critical thinking and professional excellence.
- Interest in the conservation and utilization of genetic resources of horticultural crops.

Autonomy and Responsibility

- Ability to independently interpret genetic information and draw professional conclusions.
- Responsible application of genetic and genomic findings in research and breeding activities.
- Ability to formulate independent professional opinions regarding the genetic background of economically important traits.

Course Description

Course title / Neptun code: Instrumental methods in fruit analysis / KERTU149N	Number of credits: 6
Course coordinator (name, position, academic degree): Gitta Ficzek, PhD, associate professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/ <u>seminar</u> / <u>practical</u> / consultation, and total number of contact hours in the semester: 2 contact hours/week	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): The course uses practical instrumental lab work. Demonstration measurements, data-interpretation practices, and research examples help students learn the analytical methods in a routine way.	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: creating a lab report	
Recommended semester: 1- 4	
Prerequisites (if any): -	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
The success of fruit growing depends on choosing the right variety, and the food industry also has special requirements for the quality of the raw fruit used for different products. The aim of the course is to help students learn modern physical, chemical, and instrumental methods for fruit analysis, and use them routinely in their own research work. The course provides an overview of the theoretical foundations and measurement techniques used to determine fruit-quality characteristics.	
Course Topics / Semester Schedule: Fruit physical properties — Basic methods to measure weight, size, dry matter, acidity, sugar/acid ratio, and use of simple modern tools. Texture and rheology — Simple models of fruit firmness and instrumental texture-measurement basics. Color measurement — How the color meter works, basics of the CIE color system, and simple lab color checks.	

Bioactive compounds — Easy theory and basic steps of HPLC and spectrophotometry for polyphenols, antioxidants, organic acids, and vitamins.

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

1. Ficzek G. (2021): A gyümölcsminőségi és áruérték meghatározásánál végzett fizika, analitikai és műszeres analitikai vizsgálatok ismertetése, egyetemi jegyzet
2. Skoog, D. A. – Holler, F. J. – Crouch, S. R. — *Principles of Instrumental Analysis*, 7th Edition. Cengage Learning, 2017. ISBN: 9781305577213.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

3. Nielsen, S. S. — *Food Analysis*, 5th Edition. Springer, 2017. ISBN: 9783319457765.
4. Sahlin, T. — *Food Texture and Rheology*. CRC Press, 2021. ISBN: 9780367480463.
5. Hunter, R. S. – Harold, R. W. — *The Measurement of Appearance*, 2nd Edition. Wiley, 1987. ISBN: 9780471838010.
6. Wrolstad, R. E. (ed.) — *Food Analytical Chemistry*. Wiley, 2013. ISBN: 9780470591534.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

The course helps students learn basic fruit-analysis methods, use instruments confidently, think precisely, and work independently in the lab.

Course Description

Course title / Neptun code: Environment friendly methods in the regulation of horticultural pests / NVVED098N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. habil. József FAIL, associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Árpád SZABÓ, associate professor, PhD	
Course type: compulsory / <u>elective</u>	
Type of class: 2 hours lecture/week, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): processing of case studies	
Requirements for successful completion: preparation and submission of a study on environmentally friendly control technologies against agreed horticultural plant pests	
Assessment methods applied for evaluating learning outcomes: professional evaluation of the submitted study (does it contain the most important technological descriptions, is it up-to-date)	
Recommended semester: 3-4	
Prerequisites (if any): none	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The course focuses on the possibilities and limitations of introducing environmentally friendly control methods against major horticultural pests. It builds on the agrotechnical and other knowledge that students have previously learned from crop production methods and can be used to limit the population of pests. In a case study prepared within the course, the student models the possibilities of controlling pests of a horticultural plant and its impact on the entire pest assemblage of the given crop.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Advantages and disadvantages of using synthetic zoocides, overview of agrotechnical methods with plant protection effects, horticultural crops resistant to pests, biological control in plant protection against pests, natural products that can be used for pest control, other options for controlling pest populations.</p> <p>Students learn environmentally friendly management technologies targeting the sustainable control of key animal pests of horticultural crops. Including but not limited to host plant resistance, biological control, mating disruption, biofumigation, solarisation, attract and kill as well as push and pull strategies.</p>	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	

- Ciancio A. and Mukerji K. G. (eds.) 2008 Integrated management and biocontrol of vegetable and grain crops nematodes. Springer, Dordrecht, The Netherlands, pp. 360. ISBN: 9781402060625
- Ciancio A. and Mukerji K. G. (eds.) 2009 Integrated management of fruit crops and forest nematodes. Springer, Dordrecht, The Netherlands, pp. 350. ISBN: 9781402098574
- Ciancio A. and Mukerji K. G. (eds.) 2010 Integrated management of arthropod pests and insect borne diseases. Springer, Dordrecht, The Netherlands, pp. 366. ISBN: 9789048124633
- Hoy M.A. 2011 Agricultural acarology: introduction to integrated mite management CRC Press, Boca Raton, FL, USA, pp. 410. ISBN: 9781439817513

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Dhang P. (ed.) 2014 Urban insect pests: Sustainable management strategies. CAB International, Oxon, UK, pp. 249. ISBN: 9781780642758
- Ishaaya I., Palli S.R. and Horowitz A.R. (eds.) 2012 Advanced technologies for managing insect pests. Springer, Dordrecht, The Netherlands, pp. 326. ISBN: 9789400744974
- Radcliffe E.B., Hutchison W.D. and Cancelado R.E. (eds.) 2008 Integrated pest management: concepts, tactics, strategies and case studies. Cambridge University Press, Cambridge, UK, pp. 529. ISBN: 9780521875950
- Reddy P.P. 2014 Biointensive integrated pest management in horticultural ecosystems. Springer, Dordrecht, The Netherlands, pp. 277. ISBN: 9788132218449

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Students who have completed the course will learn about the most commonly used and widespread technologies for environmentally friendly pest control. They will know and understand innovative plant protection methods, procedures and solutions. They will recognize the possibilities and limitations of biological control of horticultural plant pests. They will be able to plan and carry out studies to test new, environmentally friendly control methods. They will be able to make responsible decisions in comparing the effectiveness and environmental impact of conventional and sustainable control methods.

Course Description

Course title / Neptun code: Methods and results in pomological cultivar evaluation / KERTU119N	Number of credits: 6
Course coordinator (name, position, academic degree): László Szalay DSc full professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 28 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): processing of literature knowledge, laboratory practice, theoretical education	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: personal project	
Recommended semester: both	
Prerequisites (if any): <i>no</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>The success of fruit production is fundamentally determined by what species and within them what cultivars are planted in the plantation. The exploration of the inherited characteristics of varieties requires detailed research work. Students become familiar with the methods and results of this in this subject. The Department of Pomology of MATE, has a long tradition of researching the value of fruit species grown in our country. The Department has also been involved in the breeding of certain species for a long time. The experimental plantation in Soroksár is the base for the open-field investigation of phenological processes and morphological characteristics, while the instrumental investigations are carried out in the laboratories of the Department. In this way, students also become familiar with the practical application of the methods.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Topics:</p> <ol style="list-style-type: none"> 1 Apple 2 Pear 3 Cherries 4 Plums 5 Apricots 6 Peaches 7 Strawberries, raspberries, blackberries 	

<p>8 Currants, gooseberries, black elderberries 9 Walnuts, chestnuts, hazelnuts 10 Cultivar association</p>
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>G. Tóth Magdolna (szerk.): Gyümölcsészet. Primom Kiadó, Nyíregyháza, 2001. ISBN 963 04 9111 7</p> <p>Soltész M. (szerk.) 1998. Gyümölcsfajta-ismeret és -használat. Mezőgazda Kiadó, Budapest. 513 p. ISBN 963 9121 48 7</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Bellini, E. 2007. The Fruit Woody Species. ARSIA, Firenze. Volume 1. and 2. 1069 p.</p> <p>Tóth M. 2013. Az Alma. Magyarország Kultúrflórája. II. kötet. 3. füzet. Agroinform Kiadó, Budapest. 416 p. ISBN 978-963-502-968-6</p> <p>Pénzes B., Szalay L. 2003. Kajszi. Mezőgazda Kiadó, Budapest. 400 o. ISBN 963 286 023 3</p> <p>Nyéki J., Soltész M, Szabó Z. 2002. Fajtatársítás a gyümölcsültetvényekben. Mezőgazda Kiadó, Budapest. 382 p. ISBN 963-9358-60-6</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>Students will learn about the methods and latest results of fruit cultivar evaluation research.</p>

Course Description

Course title / Neptun code: Environmental adaptability of fruit-bearing plants / KERTU127N	Number of credits: 6
Course coordinator (name, position, academic degree): László Szalay DSc full professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 28 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theoretical education, consultation, processing of specialized literature knowledge	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: personal project	
Recommended semester: both	
Prerequisites (if any): <i>no</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>A fundamental prerequisite for successful fruit production is that the environmental conditions of the growing site be in harmony with the plants' needs, and that environmental stressors not exceed the tolerance levels of plants. Some of the fruit species in practice are native to Hungary, but there are also those whose primary gene centres are located far from us. We must proceed with even greater care when selecting their growing sites and cultivars, which requires a precise understanding of the limits of their environmental adaptability. Within the scope of this course, we will examine in detail the frost and winter hardiness, drought and heat tolerance, changes in their water and nutrient metabolism resulting from stress, the relationship between environmental conditions and physiological-biochemical processes, and the connections between tolerance and phenological processes. Among these topics, we place special emphasis on those related to the doctoral research topics of students.</p>	
<p>Course Topics / Semester Schedule:</p> <p>1 The relationship between fruit trees and their environment 2 Abiotic stress 3 Water and nutrient supply</p>	

- 4 Biotic stress
5 Technology based on physiological processes
6 Precision methods for eliminating stress

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Sansavini, S., Costa, G., Gucci, R., Inglese, P., Ramina, A., Xiloyannis, C., Desjardins, Y. (eds.) 2019. Principles of Modern Fruit Science. International Society for Horticultural Science, Leuven, Belgium. ISBN 978-94-6261-204-4

Tromp, J., Webster, A.D., Wertheim, S.J. 2005. Fundamentals of Temperate Zone Tree Fruit Production. Backhuys Publishers, Leiden, The Netherlands. 400 p. ISBN 90-5782-152-4

Faust, M. 1989. Physiology of Temperate Zone Fruit Trees. John Wiley and Sons, New York.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

DeJong, T.M. 2022. Concepts for understanding fruit trees. CABI Publisher, UK, USA. ISBN 9781800620865

Ryugo, K. 1988. Fruit culture: Its science and art. John Wiley and Sons. New York. 344 p.

Westwood, M.N. 1993. Temperate-zone pomology. Timber Press. Portland, Oregon, USA, 515 p.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Practical fruit growers and researchers involved in this field must also be familiar with the functioning of plants, their environmental needs and their responses to stress. Students in this course will expand their knowledge in this area.

Course Description

Course title / Neptun code: Biological and technological aspects of modern fruit storage, KERTU128N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Gergely Simon, associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Gitta Ficzek, associate professor, PhD	
Course type: elective	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): <ul style="list-style-type: none"> • Specific fruit storage technology descriptions by different fruit species • Case studies on the relationship between storage conditions, storage losses and storage disorders • Individual project work on the topic of fruit storage, related to the subject of the PhD research topic 	
Requirements for successful completion: Colloquium (can be changed by an individual project assignment)	
Assessment methods applied for evaluating learning outcomes: Oral examination (alternative an offered examination grade based on the individual project work)	
Recommended semester advanced in 2 nd – 3 rd -4 th	
Prerequisites (if any):	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>Profitable fruit marketing requires off-season sales. This necessitates storing fruit cost-effectively while maintaining high quality. To meet market demands, the fruit sold must be sound and free from storage-related disorders. The course aims to review the physiological principles of fruit storage, explore potential storage technologies - including pre- and post-harvest factors - identify storage losses and their causes, and briefly outline opportunities for further developing modern fruit storage methods.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The course covers the following topics:</p> <ul style="list-style-type: none"> • the origins and evolution of storage research abroad and in Hungary; • physiological, technical, and economic researches related the fruit storage; • symptoms and causes of storage losses and disorders, as well as environmental and cultivation factors affecting fruit storage; • fruit storage conditions and methods, along with opportunities for their development; • fruit-specific storage technology tasks; 	

- - the "history" of stored fruit and its impact—specifically, the influence of cultivation practices on storability and fruit quality.

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Kader, A.A. (2002) Postharvest Technology of Horticultural Crops. University of California Agriculture & Natural Resources. Publication 3311. 535 pp, 2002.
ISBN 978-1879906518

Pál Sass 1993. Fruit storage. Mezőgazda Kiadó, Budapest, 348 pp
ISBN 9638160276

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Chandra Gopala Rao 2016. Engineering for Storage of Fruits and Vegetables.
Academic Press, ELSEVIRE. ISBN: 978-0-12-803365-4

Ghulam Khaliq, Sajid Ali, Mohammed Wasim Siddiqui /Eds/ 2026. Physiological Disorders of Fruits and Vegetables Causes and Remedies. 454 Pages Published by Apple Academic Press, ISBN 9781998511327

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Upon completion of the course, students will be able to understand the technological processes involved in fruit storage and to select the appropriate pre- and postharvest technological methods depending on the fruit species being stored. They will also be able to identify the causes of storage losses and storage disorders occurring during storage.

Students will know the technological requirements and fruit storage protocols and understand the responsibilities associated with adhering to them.

Students after the course able to identify and analyse cause-and-effect relationships throughout the fruit storage process.

Course Description

Course title / Neptun code: Technological innovations of integrated fruit production, KERTU129N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Gergely Simon, associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: elective	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 13 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): <ul style="list-style-type: none"> • Specific integrated fruit growing technology descriptions by different fruit species and cultivars; • Case studies on the modern integrated fruit growing technologies of different fruit species and cultivars; • Individual project work on planning of integrated fruit growing technology, related to the subject of the PhD research topic 	
Requirements for successful completion: Colloquium (can be changed by an individual project assignment)	
Assessment methods applied for evaluating learning outcomes: Oral examination (alternative an offered examination grade based on the individual project work)	
Recommended semester advanced in 2 nd – 3 rd -4 th	
Prerequisites (if any):	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>Within the framework of the course, students will be introduced to the possibilities of implementing the latest and most advanced technological solutions in integrated fruit growing technology systems.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The course covers the following topics:</p> <ul style="list-style-type: none"> • modern solutions for climate-change-related and necessary crop production technologies, including irrigation, fertigation, frost protection, hail protection, rain protection, shading, etc.; • intensive fruit production technology and training systems applied in practice, as well as the physiological and theoretical knowledge required for their development; 	

<ul style="list-style-type: none"> modern technological methods and innovative technical developments applied in leading countries in integrated fruit production will be presented, together with quality control systems for food industrial raw materials and fresh market products.
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Manoj Kundu, Hidayatullah & Mir Ruby Rani 2025. .Production Technology of Fruit and Plantation Crops. (free download educational book https://agrimoon.com/wp-content/uploads/Production-Technology-of-Fruit-and-Plantation-Crops.pdf) BIHAR AGRICULTURAL UNIVERSITY, SABOUR BHAGALPUR -813210 Ashwani Kumar Singh, Manjunath Rathod, Hari Baksh, Lalit Dhurve 2023. Fruit Growing Technology. Weser Books, Germany, 228 pp, ISBN 978-3-96492-549-7.</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Chris Whitelock 2025. Growing Fruit – A practical guide to growing top and soft fruit. The Crowood Press Ltd. 160 pp, ISBN 9780719845390 John Burton 2024. Growing Fruit Trees. 192 pp. ISBN 1999425669</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>Upon completion of the course, students will be able to understand the technological system of integrated fruit production and identify and apply the most optimal, cost-effective, and environmentally conscious solutions to the requirements of the fruit species and cultivars. Student attitude developed during the course: Students strive for self-directed learning and remain open to new professional and technological solutions of integrated fruit growing.</p>

Course Description

Course title / Neptun code: Application of Molecular Techniques in Plant Breeding	Number of credits: 6
Course coordinator (name, position, academic degree): Júlia Halász, Professor, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: elective	
Type of class: 18 lectures + 8 practical hours per semester	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Knowledge is delivered through lectures and practical classes. The course utilizes presentations, scientific literature, and digital learning materials. Theoretical concepts are complemented by practical demonstrations, laboratory exercises, instrument-based demonstrations, and independent data analysis assignments. The learning process is further supported by the use of digital databases and specialized software tools.	
Requirements for successful completion: exam	
Assessment methods applied for evaluating learning outcomes: oral exam	
Recommended semester 3-4	
Prerequisites (if any): genetics	
<p>Course Description</p> <p>The course provides PhD students with an opportunity to become familiar with molecular techniques supporting plant breeding, with particular emphasis on methods applied in horticultural plant species and the achievements obtained through their use. The course reviews both conventional molecular markers and next-generation molecular diagnostic methods, illustrating their advantages and limitations in various horticultural crops and breeding applications through specific examples.</p> <p>Students gain practical experience with selected molecular techniques. The course introduces the fundamentals of molecular breeding, methods for modifying inherited traits through genetic transformation and genome editing, and approaches for detecting and characterizing genomic changes.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The role of molecular breeding in horticultural crop improvement</p> <p>Types and characteristics of molecular markers</p> <p>Conventional molecular marker techniques</p> <p>SNP markers and high-throughput genotyping</p> <p>Linkage mapping and QTL analysis</p> <p>Marker-assisted selection (MAS)</p>	

<p>Next-generation sequencing technologies</p> <p>Molecular diagnostic methods</p> <p>Genetic transformation in plants</p> <p>Genome editing technologies</p>
<p>List of the 2–5 Most Important Required Literature</p> <p>Kumar, R., Das, S.P., Choudhury, B.U. et al. (2024). Advances in genomic tools for plant breeding: harnessing DNA molecular markers, genomic selection, and genome editing. <i>Biological Research</i>, 57, 80. https://doi.org/10.1186/s40659-024-00562-6</p> <p>Hasan, N., Choudhary, S., Naaz, N., Sharma, N., & Laskar, R.A. (2021). Recent advancements in molecular marker-assisted selection and applications in plant breeding programmes. <i>Journal of Genetic Engineering and Biotechnology</i>, 19(1), 128..</p>
<p>List of the 2–5 Most Important Recommended Literature</p> <p>Nadeem, M.A., Nawaz, M.A., Shahid, M.Q., Doğan, Y., Comertpay, G., Yıldız, M., & Baloch, F.S. (2018). DNA molecular markers in plant breeding: current status and recent advancements in genomic selection and genome editing. <i>Biotechnology & Biotechnological Equipment</i>, 32(2), 261-285.</p> <p>Amiteye, S. (2021). Basic concepts and methodologies of DNA marker systems in plant molecular breeding. <i>Heliyon</i>, 7(10).</p>
<p>Professional Competences Developed by the Course</p> <p>Knowledge</p> <p>Understands the fundamentals of molecular genetic and genomic approaches used in plant breeding.</p> <p>Understands the applications of molecular markers, next-generation sequencing (NGS) technologies, genetic transformation, and genome editing.</p> <p>Skills</p> <p>Able to select appropriate molecular methods and evaluate their applicability.</p> <p>Able to interpret molecular genetic data and apply them in breeding programs.</p> <p>Able to perform basic molecular laboratory techniques.</p> <p>Attitude</p> <p>Open to the application of innovative molecular breeding approaches.</p> <p>Strives to develop a scientifically sound and critical professional perspective.</p> <p>Autonomy and Responsibility</p> <p>Able to independently process scientific literature and formulate professional conclusions.</p> <p>Responsibly applies and evaluates results obtained from molecular methods in research and breeding activities.</p>

Course Description

Course title / Neptun code: MATER075N Multivariate Statistical Analysis	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. András Ittész, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Márta Ladányi, DSc	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/ <u>seminar</u> / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theory, case-study analyses, project-based learning	
Assessment methods applied for evaluating learning outcomes: report	
Recommended semester: spring (second or third)	
Prerequisites (if any): <i>advanced level statistical knowledge</i>	
Assessment methods applied for evaluating learning outcomes: commented evaluation of the project work	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>During the semester, students will build on their knowledge acquired in BSc, MSc, or PhD-level Biometrics and Statistics courses. Selected chapters of multivariate statistics, focusing on complex applications, will be explored through practical discussions and numerous examples, particularly from agriculture. The content is tailored to meet the needs of PhD students.</p> <p>The course is taught online, using RStudio as the primary statistical software. Additionally, the block teaching plan is developed in consultation with the students to ensure it aligns with their learning objectives.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The curriculum covers several multivariate statistical methods and focuses on the details of the practical application of the methods, in addition to the basic theoretical background required by the users, in line with the participants' own doctoral work. RStudio software will be used for the practical implementation of the calculations and analyses.</p> <ul style="list-style-type: none"> - General linear models including MANOVA - Multiple linear regression - Logistic regression - Partial least squares regression - Discriminant analysis - Cluster analysis 	

- Principal component analysis
- Other multivariate statistical methods, some based on machine learning algorithms (PLS, SVM, Random Forest, Generalized Mixed Effects Models etc)

List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Special handouts are available in electronic form during the course via the e-learning system.

List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Tabachnick, B. G., & Fidell, L. S. (2022). Using Multivariate Statistics (7th ed.). Pearson. ISBN-13: 9780137526543
Field, Andy P. (2026). Discovering Statistics Using R and RStudio. SAGE Publications. ISBN 978-1-5264-6136-0
Podani J. (1994). Multivariate Data Analysis in Ecology and Systematics. SPB, The Netherlands. Ecological Computations Series, vol. 6. ISBN 90-5103-0940
Podani J. (2000). Introduction to the Exploration of Multivariate Biological Data. Backhuys Publishers, Leiden, The Netherlands. ISBN 90-5782-067-6

Professional Competences Developed by the Course
Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:
Knowledge, Skills, Attitudes, Autonomy and Responsibility

- a) Knowledge** Students acquire statistical methods in RStudio environment based on real-world research, directly supporting the multivariate data analyses required for their experimental or observational research, as well as their literature review work.
- b) Skills** Students will be able to analyse complex multivariate data arising from biological-chemical research in a statistically and ethically sound manner, as well as interpret, visually present, and communicate results to a scientific standard.
- c) Attitude** Students develop the scientific rigor necessary for performing high-quality multivariate statistical analyses and for critically and insightfully reading statistical analyses in scientific journals.
- d) Autonomy and Responsibility** Students learn to conduct multivariate data analysis independently, responsibly, honestly, and precisely.

Course Description

Course title / Neptun code: FFGAZ291N	Number of credits: 6
Course coordinator (name, position, academic degree): Péter, PUSZTAI, associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Izóra, GÁL, associate professor, PhD	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 2/0, 28/0 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Case Studies – evaluation of typical farming situations in accordance with the principles and regulations of organic farming; Project Work – presentation and evaluation of sustainability situation in the student's own local community in accordance with the principles and regulations of organic farming;	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: 5 grade scale	
Recommended semester 3-4	
Prerequisites (if any): -	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
Basic knowledge of organic farming could be essential for PhD students related to their research fields. The course focuses on current organic sector problems and gives a wide perspective on the possible solutions based on legislation and scientific methodology. It is important to know why organic farming has to clearly define a special way of life standards instead of simplifying pure non-chemical farming technology variation.	
Course Topics / Semester Schedule: <ul style="list-style-type: none"> - The necessity of the emergence of organic farming; - The common features and differences among various trends in organic farming, depending on the circumstances of their emergence; - Social demands and requirements for organic farming; - Ethical issues in organic and conventional production; - The legal background and its consequences in the European Union; - Domestic challenges related to organic farming; - Technological challenges and research findings in organic farming; - The relationship between nature, the environment, and agriculture; - Habitat creation and conservation in agriculture 	
List of the 2–5 Most Important Required Literature	

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

EU Regulations

- 2018/848 EU
- 2020/464 EU
- 2021/1165 EU

Course elearning materials

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Rachel Carson (2021): Silent Spring, Folio Society, 328 pages, ISBN: 9789375669500
- Nicolas Lampkin (1990): Organic Farming, Diamond Farm Book Pubns, 720 pages, ISBN: 9780852361917

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

a. Knowledge

- Has a broad knowledge of global environmental problems.
- Has a broad knowledge of global nature conservation problems.
- Has specialized knowledge of sustainability.
- Has specialized knowledge of sustainable agriculture.
- Has comprehensive knowledge of the relationship of environmental and nature conservation to organic farming

b. Skills

- Can evaluate organic farming systems
- Can identify the ecological risks of production
- Can operate on an international scale
- Can improve their professional skills

c. Attitude

- Critically evaluates various agricultural technologies
- Is interested in possibilities for innovation
- Strives for lifelong learning

d. Autonomy and Responsibility

- Makes responsible decisions regarding the production of food of appropriate quality and quantity
- Contributes to environmental protection through professional development
- Shares innovative ideas with the scientific community

Course Description

Course title / Neptun code: Virology/NVVED086N	Number of credits: 6
Course coordinator (name, position, academic degree): Mrs. Koós, Dr. Erzsébet Szathmáry, Assistant Professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ <u>elective</u>	
Type of class: <u>lecture</u> /seminar / practical / consultation, and total number of contact hours in the semester: 42 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Knowledge transfer is carried out through lectures using presentations, illustrative materials, and schematic diagrams. During the course, theoretical concepts are discussed, including the explanation of fundamental concepts, biological processes, and relationships, as well as the presentation of diagnostic and plant protection methods. The transfer of theoretical knowledge is supported by illustrative examples related to the most important plant viruses and the symptoms of diseases caused by them, as well as by the presentation of diagnostic methods and scientific research results.	
Requirements for successful completion: Examination	
Assessment methods applied for evaluating learning outcomes: Knowledge assessment is carried out in the form of a written or oral examination, which evaluates the students' knowledge of the complete course material, their understanding of basic concepts and processes in plant virology, and their acquired knowledge related to the diagnosis of plant viruses and possibilities for their control.	
Recommended semester: 1 st –4 th (spring) semester	
Prerequisites (if any):	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The aim of the course is to provide students with a comprehensive overview of the traditional and molecular aspects of plant virology. Students become familiar with the history of plant virology, the structure, movement, and transmission mechanisms of plant viruses, the basic principles of viral replication and genome organization, as well as the characteristics of viral gene expression. The course also introduces the most important plant viruses and the symptoms caused by them. Students gain insight into methods used for the detection of plant viruses and into possibilities for the control of plant viral diseases.</p>	
<p>Course Topics / Semester Schedule:</p> <ul style="list-style-type: none"> - History of plant virology 	

- General characteristics of plant viruses (definition, morphology, taxonomy, transmission)
- Movement of plant viruses within plants
- Replication of plant viruses (assembly and disassembly)
- Replication and translation strategies of plant viruses
- Identification and characterization of plant viral diseases
- Satellite viruses
- Satellite RNAs
- Viroids and viroid replication
- Molecular diagnostics of plant viruses (nucleic acid-based detection methods, PCR, serological methods, bioassays)
- Possibilities for controlling plant viruses

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Hull, R. (2002): Matthew's Plant Virology. Academic Press, London, UK. ISBN: 0-12-361160-1

Walkey, D. G. A. (1991): Applied Plant Virology (2nd Edition). Chapman and Hall/Springer. ISBN: 978-0-412-35740-4

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Flint, J., Racaniello, V. R., Rall, G. F., Hatzioannou, T., Skalka, A. M. (2020): Principles of Virology, Multi-Volume, 5th Edition. ASM Press. ISBN: 978-1-683-67358-3

Knipe, D. M. and Howley, P. M. (eds.) (2021): Fields Virology: Emerging Viruses. 7th Edition. Wolters Kluwer. ISBN: 978-1-9751-1254-7.

Knipe, D. M. and Howley, P. M. (eds.) (2021): Fields Virology: DNA Viruses. 7th Edition. Wolters Kluwer. ISBN: 978-1-9751-1257-8.

Knipe, D. M. and Howley, P. M. (eds.) (2022): Fields Virology: RNA Viruses. 7th Edition. Wolters Kluwer. ISBN: 978-1-9751-1260-8.

Knipe, D. M. and Howley, P. M. (eds.) (2023): Fields Virology: Fundamentals. 7th Edition. Wolters Kluwer. ISBN: 978-1-9751-1251-6

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge: Students acquire knowledge of the structure, movement, replication, and transmission of plant viruses, as well as the characteristics of the most important plant

viral diseases. They gain knowledge of traditional and molecular methods for virus detection and of possible strategies for controlling plant viruses.

Skills: Students are able to recognize the characteristic symptoms of plant viral diseases, interpret basic diagnostic methods, and select appropriate plant protection measures for the prevention and management of viral diseases.

Attitude: Students strive to apply up-to-date plant protection knowledge. They recognize the importance of accurate and reliable diagnostic procedures in virus detection and support the application of environmentally friendly approaches in plant protection.

Autonomy and responsibility: Students are able to independently identify and evaluate basic professional problems related to plant viruses. They apply their acquired knowledge responsibly during diagnostic procedures and plant protection activities.

Course Description

Course title / Neptun code: Molecular taxonomy, Phylogenetics and Phylogeography	Number of credits: 8
Course coordinator (name, position, academic degree): Prof. Dr. Maria Höhn CSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 24 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Study of taxonomic databases and review of the rules of nomenclature through the discussion and evaluation of specific case studies.	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: Evaluation of a case study and written report	
Recommended semester: 1 or 2	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The course introduces modern taxonomic systems based on molecular evidence, the principles and patterns underlying phylogenetic structures, and the principal rules of biological nomenclature. Students become familiar with the major databases containing taxonomic, nomenclatural and molecular data and acquire proficiency in their use. The course analyses and discusses systematic, nomenclatural and evolutionary topics concerning natural and cultivated taxa. Topics include the fundamentals of DNA-based species identification, the use of genetic markers to reveal phylogenetic relationships and relatedness patterns, and the interpretation of taxonomic problems arising in plant breeding. The course aims to develop the critical perspective required to evaluate molecular data and interpret results, and to prepare students to apply these methods proficiently in their PhD research.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Course topics / semester syllabus:</p> <ul style="list-style-type: none"> - Fundamental principles, rules and key relationships in molecular taxonomy, phylogenetics and phylogeography. - Presentation of classical and molecular taxonomic approaches and the integrated use of morphological, genetic, ecological and geographical data. 	

- Introduction to modern taxonomic databases and data analysis. Case studies are used to place particular emphasis on the critical evaluation of molecular results, the recognition of methodological uncertainty, and the distinction between conclusions supported by the data and possible evolutionary explanations.
- Applications of molecular markers in taxonomy; DNA-based species identification; and the fundamentals of constructing and interpreting phylogenetic trees, haplotype networks and phylogeographic relationships.
- Correct application of the names of natural and cultivated taxa. Approaches how to resolve problematic nomenclatural questions.

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Smith GF, Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber WH, Li DZ, Marhold K, May TW, McNeill J, Monro AM, Prado J, Price MJ (2018): International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. *Regnum Vegetabile*. 159. Koeltz Botanical Books for the International Association for Plant Taxonomy. <https://doi.org/10.12705/Code.2018>

- Stevens PF (2001 onwards): Angiosperm Phylogeny Website. Version 14, July 2017. <http://www.mobot.org/MOBOT/research/APweb/>.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

-Nei M, Kumar S (2000): *Molecular Evolution and Phylogenetics*. Oxford University Press, New York. ISBN 978-0-19-513585-5.

- Soltis DE, Soltis PS, Doyle JJ (eds.) (1998): *Molecular Systematics of Plants II: DNA Sequencing*. Kluwer Academic Publishers, Dordrecht, 574 pp. ISBN 978-0-412-11121-1.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility

The student is familiar with the fundamental concepts, theoretical background and principal methods of molecular taxonomy, phylogenetics and phylogeography, and understands the relationships among genetic diversity, speciation, evolutionary relationships, geographical origin and distribution. The student is familiar with and proficient in the use of systematic and taxonomic databases and can apply them to the topic of their PhD dissertation. The student understands the potential applications of DNA-based species identification and the biological significance of phylogenetic trees, haplotype networks and phylogeographic patterns. The student is able to critically evaluate molecular results, takes into account the limitations of the methods used, and understands and correctly applies the rules of nomenclature.

Course Description

Course title / Neptun code: Up-to Date Cultivation Methods of Ornamental Plants and Variety Value Research / TETTD248N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Péter Honfi associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. István Dániel Mosonyi assistant professor, PhD Dr. Máté Ördögh assistant professor, PhD Dr. Veronika Szabó assistant professor, PhD	
Course type: compulsory/elective	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 39 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Preparation of a review paper on a topic related to the course content, approved by the course coordinator, with a minimum length of 10 pages and based on at least 30 scientific literature sources.	
Requirements for successful completion: colloquium	
Assessment methods applied for evaluating learning outcomes: Students may obtain a recommended grade based on their individual coursework; alternatively, the course may be completed by passing an oral examination (colloquium) during the examination period.	
Recommended semester: free elective	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The aim of the course is to provide students with comprehensive knowledge of current national and international research trends in ornamental horticulture and cultivar evaluation, as well as the scientific principles underlying modern production technologies. Furthermore, the course develops students' ability to critically analyse the international scientific literature in the field, synthesize research findings, and apply them effectively in their own research activities.</p>	
<p>Course Topics / Semester Schedule:</p> <ul style="list-style-type: none"> • Current trends in Hungarian and international ornamental horticulture • Cultivar selection and breeding trends in greenhouse ornamental crops • Cultivar selection and breeding trends in ornamental trees and shrubs • Cultivar selection and breeding trends in herbaceous perennial ornamentals • Modern greenhouse production technologies for major ornamental crops 	

<ul style="list-style-type: none"> • Production technologies of selected cut flower crops I–III • Production technologies of selected potted ornamental crops I–III • Modern <i>in vitro</i> techniques in ornamental horticulture
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Beytes, Chris (ed., 2021): Ball RedBook, Volume 1: Greenhouse Structures, Equipment, and Technology. Ball Publishing, West Chicago, Illinois, 2021. ISBN: 978-173-325-411-3.</p> <p>Honfi, Péter, Tillyné Mándy, Andrea (ed., 2013): Modern systems in production and commerce of ornamentals. Éva Németh Zámoriné, Szilvia Sárosi, Levente Horváth: Modern Horticulture. Corvinus University of Budapest, Faculty of Horticultural Science, 2013. ISBN: 978-963-503-552-6 https://kertesztananyag.hu/modern-systems-in-production-and-commerce-in-ornamentals</p> <p>Nau, Jim; Calkins, Bill; Westbrook, Allison (ed., 2021): Ball RedBook, Volume 2: Crop Culture and Production. Ball Publishing, West Chicago, Illinois, 2021. ISBN: 978-173-325-412-0.</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Larson, Roy A. (ed.) (1992). Introduction to Floriculture. 2nd Edition. Academic Press, San Diego. ISBN: 978-012-437-651-9.</p> <p>Dole, J. M. – Gibson, J. L. (eds.) (2006). Cut Flower Production. Ball Publishing, Batavia, Illinois. ISBN: 978-188-305-236-2</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:</p> <p style="padding-left: 40px;">Knowledge, Skills, Attitudes, Autonomy and Responsibility</p> <p>Knowledge</p> <ul style="list-style-type: none"> • Demonstrates comprehensive knowledge of current national and international trends in ornamental horticulture. • Has an advanced understanding of modern production technologies used in the major ornamental crops. • Possesses comprehensive knowledge of the current objectives, methods, and achievements of ornamental plant breeding. • Understands the applications of modern <i>in vitro</i> propagation techniques and biotechnological approaches in ornamental horticulture. <p>Skills</p> <ul style="list-style-type: none"> • Is able to critically analyse and comparatively evaluate the international scientific literature in the field. • Is able to independently analyse the scientific background of production technologies and cultivar development. • Is able to synthesize research findings and prepare scientific review papers. • Is able to comparatively evaluate different production technologies and breeding strategies.

Attitude

- Is open to adopting new production technologies and advances in ornamental plant breeding.
- Is committed to evidence-based scientific decision-making.
- Recognises the importance of innovation, sustainability, and environmental considerations in ornamental horticulture.

Autonomy and Responsibility

- Is able to independently identify, process, and critically evaluate scientific literature.
- Participates responsibly in the planning and evaluation of research activities.
- Bases scientific conclusions on reliable scientific evidence and is able to critically interpret published research findings.

Course Description

Course title / Neptun code: Phytobacteriology/ NVVED097N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Anita Karacs-Végh, associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: <u>lecture</u> /seminar / practical / consultation, and total number of contact hours in the semester: 28 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods):-	
Requirements for successful completion: exam	
Assessment methods applied for evaluating learning outcomes: -	
Recommended semester 1-4	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>The aim of the course is to give students a detailed overview about the present knowledge of microbiology and bacteriology. The aim is to get to know the theoretical background of classical and molecular bacteriological studies. Macroscopy, methods for isolation and various identification of plant pathogen bacteria. Different types of microscopic examinations, biochemical methods, molecular biological methods, theory of protein and nucleic acid analysis.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Structure, motility and characterisation of bacteria; basic concepts.</p> <p>Nomenclature (plant pathogen bacteria).</p> <p>Host-pathogen interaction, life cycle, mode of life.</p> <p>Characterisation of plant-pathogenic bacterial genera.</p> <p>Microscopic examinations, morphological characterisation.</p> <p>Isolation and identification methods.</p> <p>Classical bacteriological methods.</p> <p>Biochemical and serological tests.</p> <p>Molecular bacteriological tests.</p> <p>Pathophysiological processes, resistance.</p> <p>Varietal susceptibility tests and methods.</p>	
List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)	

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.
Janse, J.D. (2009): Phytobacteriology. Cabi Publishing. Wallingford. ISBN: 9781845936006
List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.
Agrios, G.N. (szerk.) (1997): Plant Pathology (4th ed.). Academic Press. San Diego California. ISBN: 0120445646
Sambrook, J., Fritsch, E. F., Maniatis, T. (1989): Molecular Cloning: a Laboratory Manual. 2nd edn. Cold Spring Harbor Laboratory. Cold Spring Harbor. NY. U.S.A. ISBN: 9781936113422
Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility

Course Description

Course title / Neptun code: In vitro propagation of ornamental plants / TETTD252N	Number of credits: 6
Course coordinator (name, position, academic degree): István Dániel Mosonyi, assistant professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Máté Ördögh, assistant professor, PhD	
Course type: compulsory/ <u>elective</u>	
Type of class: <u>lecture</u> /seminar / practical / consultation, and total number of contact hours in the semester: 28 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Preparation of a review paper on a topic related to the course syllabus and agreed upon with the course coordinator, using at least 30 scientific references, with a length of 10 pages.	
Requirements for successful completion: oral examination	
Assessment methods applied for evaluating learning outcomes: a proposed grade may be awarded on the basis of individual work; otherwise, an oral examination is required.	
Recommended semester 1-4	
Prerequisites (if any): -	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
Fundamentals of biotechnology in ornamental plant production. The role of biotechnology in ornamental plant breeding and cultivar introduction. Stages and requirements of micropropagation (pretreatment, sterilisation, culture media, light, temperature and acclimatisation). Theoretical foundations of plant tissue culture and micropropagation. Development of micropropagation technologies for ornamental plants and research methodology for technological development.	
Course Topics / Semester Schedule: History of biotechnology 2. The plant-cell-plant system 3. Factors affecting <i>in vitro</i> cultures - sterility 4. Factors affecting <i>in vitro</i> cultures - culture medium components I 5. Factors affecting <i>in vitro</i> cultures - culture medium components II 6. Factors affecting <i>in vitro</i> cultures - plant source material 7. Factors affecting <i>in vitro</i> cultures - environmental factors 8. Stages and principal methods of <i>in vitro</i> propagation 9. Design, equipment and economic aspects of a commercial production laboratory 10. Biotechnology of sexual propagation	

<p>11. <i>In vitro</i> propagation of woody ornamental plants</p> <p>12. <i>In vitro</i> propagation of annual and herbaceous perennial ornamental plants</p> <p>13. <i>In vitro</i> propagation of tropical and subtropical ornamental plants</p>
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Park, S., 2021. Plant Tissue Culture: Techniques and Experiments, 4th ed. Academic Press, Amsterdam. ISBN-13: 9780128211205</p> <p>Jain, S.M., Ochatt, S.J. (Eds.), 2010. Protocols for In Vitro Propagation of Ornamental Plants, Methods in Molecular Biology. Humana Press, Totowa, NJ. ISBN-13: 9781603273909</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Kyte, L., Kleyn, J. 1996. Plants from Test Tubes. Timber Press, Portland, Oregon ISBN-13: 9780881923612 (introductory/remedial reading)</p> <p>Geneve, R.L., Preece, J.E., Merkle, S.A. 1997. Biotechnology of Ornamental Plants. CAB International. ISBN-13: 9780851991108</p> <p>George, E.F. 1993. Plant Propagation by Tissue Culture, Vols. I and II. Exegetics Ltd., London. ISBN-13: 9780950932545</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>Knowledge</p> <ul style="list-style-type: none"> • Understands international development trends in the ornamental plant micropropagation industry. • Understands modern <i>in vitro</i> propagation technologies for major ornamental plant crops. • Understands the requirements for designing, establishing and operating a commercial micropropagation laboratory. <p>Skills</p> <ul style="list-style-type: none"> • Can independently analyse the scientific basis of an <i>in vitro</i> propagation technology. • Can synthesise research findings and prepare a scientifically rigorous review. • Can initiate the development of <i>in vitro</i> propagation technologies for new ornamental plant taxa. <p>Attitudes</p> <ul style="list-style-type: none"> • Is open to new developments and research findings in propagation technology. • Strives to make scientifically sound decisions.

- Considers innovation, sustainability and environmental aspects important in the *in vitro* propagation of ornamental plants.

Autonomy and responsibility

- Can independently process and evaluate scientific literature.
- Participates responsibly in the planning and evaluation of research tasks.
- Bases scientific claims on reliable literature sources and is able to interpret them critically

Course Description

Course title / Neptun code: Intensive mushroom cultivation technologies (KERTU131N)	Number of credits: 6
Course coordinator (name, position, academic degree): András Geösel (PhD)	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 3+0 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Classes and analysis of individual case studies	
Requirements for successful completion: seminar	
Assessment methods applied for evaluating learning outcomes: 5 grade scale	
Recommended semester 2-4	
Prerequisites (if any): -	
<p>Course Description</p> <p>Advances in the technological standards of domestic and international mushroom cultivation, and the main areas of development. Evaluation of cultivation facilities from the perspective of intensive cultivation technologies. Presentation of modern cultivation technologies for the three most important mushroom species (button mushroom, oyster mushroom, shiitake), along with quality parameters and market requirements for processing. Steps in the domestication of wild-growing species and their introduction into cultivation. Cultivation technology and economics of medicinal mushroom species. Applied research and development in the mushroom industry; innovative technologies in the production of spawn and raw materials.</p>	
<p>Course Topics / Semester Schedule:</p> <ul style="list-style-type: none"> • Economics and market trends in mushroom cultivation • Biological foundations and physiological processes of mushroom cultivation • Technological systems for mushroom cultivation • Steps for introducing exotic mushroom species into cultivation • Biological foundations and objectives of mushroom breeding • Quality requirements for processing and preparation for market 	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	

Papp V.; Geösel A. (2024): Mikológiai kompendium: Kertészeti, szántóföldi és élelmiszeripari gombák rendszertani gyűjteménye, Gödöllő, Magyarország, Magyar Agrár- és Élettudományi Egyetem, 155 p. ISBN: 9789636230883
Györfi J.(szerk)(2011): Gombabiológia, gombatermesztés. Mezőgazda Kiadó, Budapest.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Chang S.T., Miles P.G. (2004) Mushrooms – Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact. CRC Press, USA.

Stamets P. (2000) Growing Gourmet and Medicinal Mushrooms. Ten Speed Press, Toronto

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge

- The student is familiar with technological developments in domestic and international mushroom cultivation.
- They have a thorough understanding of modern cultivation technologies for button mushrooms, oyster mushrooms, and shiitake mushrooms.
- They are familiar with the evaluation of cultivation facilities from the perspective of intensive cultivation.

Skills

- They are able to compare and optimize modern cultivation technologies.
- Is able to plan the introduction of new species into cultivation.
- Is capable of developing propagation and raw material production technologies.

Attitude

- Is committed to the development of innovative mushroom cultivation technologies based on scientific findings.
- Is open to the application of new species, technologies, and research and development results.

Autonomy and Responsibility

- Able to independently identify research and development challenges in mushroom cultivation.
- Capable of defining appropriate directions for development.
- Takes responsibility for ensuring that technological decisions are based on sound professional judgment.
- Capable of recognizing and solving practical problems.

Course Description

Course title / Neptun code: Classical and molecular genetics GENBT095N	Number of credits: 8
Course coordinator (name, position, academic degree): Zsuzsanna Benyóné György, professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):-	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / <u>consultation</u> , and total number of contact hours in the semester: .40 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Within the framework of individual consultations, genetic and molecular biological topics related to the doctoral research project of the PhD student are explored in depth. The selected subject areas, agreed upon by the supervisor and the student, are studied through independent literature review and analysis. Knowledge acquisition is supported by the joint selection of relevant literature sources, critical evaluation of scientific publications, and regular consultations. These consultations provide an opportunity to discuss emerging theoretical and methodological issues and to deepen the student's understanding of the genetic foundations of the research project.	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: Evaluation of the student's independent literature review and professional preparedness through oral consultations. Assessment of the student's knowledge of the selected genetic topics, ability to critically interpret the scientific literature, and capacity to relate the acquired knowledge to their research project, carried out in the form of an oral colloquium.	
Recommended semester: 1 st or 2 nd semester	
Prerequisites (if any): BSc level genetics studies	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The aim of this course is to deepen the doctoral student's knowledge of classical and molecular genetics related to their research topic and to broaden this knowledge with up-to-date scientific findings. Tailored to the individual research needs of the student, the course provides opportunities for the study of specialized genetic topics, the independent and critical analysis of relevant scientific literature, and the application of acquired knowledge to the student's research activities. Through individual consultations, the course supports the interpretation of the selected topics and promotes a scientifically rigorous approach to addressing genetic questions arising during the research process.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Independent study of genetic topics related to the doctoral research project, selected in consultation with the student and tailored to the specific needs of the research topic.</p>	

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Klug, W. S., Cummings, M. R., Spencer, C. A., Palladino, M. A. (2014): Concepts of Genetics. Pearson Education, Boston, USA. ISBN: 978-0-321-94670-8.

Weaver, R. F. - Hedrick, P. W. (2000): Genetika. Panem Könyvkiadó, Budapest. ISBN: 963-545-255-1.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

The recommended literature is selected according to the student's individual research topic and primarily includes current international scientific publications, review articles, and relevant book chapters related to the subject area. The literature base is updated as necessary to reflect recent advances and emerging developments in the field.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge

Advanced knowledge of genetic and molecular genetic disciplines related to the student's research topic.

Understanding and interpretation of the relevant scientific literature in the field.

Skills

Independent critical analysis and evaluation of scientific publications.

Ability to identify and apply genetic concepts and relationships within the student's own research area.

Application of molecular genetic approaches to research questions and scientific problem-solving.

Attitudes

Openness to new scientific findings and methodological developments.

Commitment to continuous professional development and lifelong learning.

Autonomy and Responsibility

Ability to conduct independent literature searches and build subject-specific knowledge autonomously.

Responsible application of acquired knowledge in the planning, implementation, and interpretation of research activities.

Course Description

Course title / Neptun code: Scientific bases of vegetable production (KERTU120N)	Number of credits: 6
Course coordinator (name, position, academic degree): András Geösel, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 3+0 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Classes and analysis of individual case studies.	
Requirements for successful completion: seminar	
Assessment methods applied for evaluating learning outcomes: 5 grade scale	
Recommended semester 1-2	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>The aim of vegetable production is to produce high-quality food in a cost-effective manner, applying the latest knowledge in plant physiology, plant nutrition, and cultivation techniques. By learning about the cultivation techniques for the most important vegetable species, students gain a comprehensive understanding of trends in vegetable production in the domestic and global markets, as well as domestic and international trends in research and development. The aim of the course is to prepare students to critically analyze vegetable production systems, scientifically evaluate new technologies, and formulate independent research questions through the application of modern research methods, experimental design, and data analysis approaches. This course covers the nutritional and economic significance of vegetables, as well as the characteristics of vegetable consumption in Hungary. We will discuss the specific features of vegetable cultivation, its geographical distribution, and the major vegetable-growing regions in Hungary. Based on scientific findings, the course covers the cultivation, harvesting, sorting, packaging, and storage of vegetable crops, as well as soil management practices and crop rotations used in vegetable production. It also covers the most up-to-date methods of open-field and greenhouse vegetable production, as well as biotechnological processes.</p> <p>Trends in Vegetable Production in Hungary and on the Global Market</p>	

- Precision Nutrient Management Strategies in Greenhouse Cultivation
- Modern Mushroom Cultivation Systems
- Nutritional values of vegetable crops
- Analysis of water requirements in vegetable production
- Energy consumption in the vegetable sector
- Data-driven decision support in vegetable production

Course Topics / Semester Schedule:

List of the 2–5 Most Important Required Literature
(textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Terbe-Hodosi-Kovács (2005): Zöldségtermesztés termesztőberendezésekben.
ISBN: 9789632865799

Digital KWIn Arable Farming and Field Vegetables (2025) Wageningen University

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)
Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Prohens J., Nuez F. (2008): Vegetables I-II. Springer Book. ISBN: 978-1489997647
Digital KWIn Arable en Vegetable crops (2026) Wageningen University

Professional Competences Developed by the Course
Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge

- System-level understanding of the biological, physiological, genetic, ecological, and technological interrelationships in vegetable production systems.
- Up-to-date knowledge of the interactions between genotype, environment, and production technology that determine crop yield and quality, as well as stress physiology processes.
- Knowledge of the scientific foundations of precision, controlled-environment, and efficient production systems.
- Knowledge of state-of-the-art vegetable production research methods, as well as experimental design, statistical, and data interpretation procedures.

Skills

- Independent, critical, and interdisciplinary analysis of complex vegetable production problems.
- Formulation of scientific hypotheses and research questions.
- Independent design of experiments and quantitative analysis of the effects of production factors.
- Critical review of the international literature.
- Evaluation of new scientific findings and determination of their significance for production technology.

Attitude

- Commitment to objective and critical vegetable production research.
- Openness to the application of new scientific methods and technologies.
- Emphasis on the reproducibility and validation of scientific results.
- Critical assessment of practical applicability.

Autonomy and Responsibility

- Ability to independently identify and articulate current scientific problems in vegetable production.
- Independently plans, organizes, and evaluates the research process.
- Makes professionally sound decisions.
- Ability to draw independent, original scientific conclusions.

Course Description

Course title / Neptun code: Modern propagation material usage in vegetable production/ KERTU132N	Number of credits: 6
Course coordinator (name, position, academic degree): Noémi Kappel PhD full professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 2 lecture/26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Presentation of the practical and economic background of vegetable seed and seedling production with case studies. The student must carry out their own project work and prepare a plan for the production of propagation material for a given vegetable crop.	
Requirements for successful completion: oral exam	
Assessment methods applied for evaluating learning outcomes: preparation of a propagation plan, oral exam	
Recommended semester: 3-4	
Prerequisites (if any):	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
The subject covers three main topics: 1. Theoretical, practical and legal aspects of variety use in vegetable production. 2. The path of seed in the process of propagation to commodity. Important knowledge for seed use. Chemical, biological and mechanical processes used for seed certification and evaluation. 3. The seedling as propagating material (control system, from sowing to marketing). Use of grafted seedlings in vegetable production. The process of grafting, rootstock use, advantages and disadvantages of grafting.	
Course Topics / Semester Schedule: Propagation methods used in vegetable production. Sowing, seedling cultivation. Concept and quality of seed. Seed treatment procedures. Vegetable seed production. Ecological conditions of seedling cultivation, their regulation. Seedling cultivation for different vegetable crops. Application of grafted seedlings in vegetable production.	

<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Presentations of lectures in pdf format on elearning Donald N. Maynard and George J. Hochmuth (2007): Knott's Handbook for Vegetable Growers. 630 p.</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>J. Benton Jones Jr. (2005): Hydroponics. A Practical Guide for the Soilless Grower. 439</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>By completing the course, relying on their knowledge, graduates would become capable of independent decision-making management and innovative development in the field of vegetable seed and seedling cultivation.</p>

Course Description

Course title / Neptun code: Plant-Associated Microbiomes and Postharvest Preservation Strategies in Horticultural Practice/ ELTUD523N	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. Kocsis Tamás József, Associate Professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/elective elective	
Type of class: lecture and consultation, and total number of contact hours in the semester: 20 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Knowledge is delivered through lectures and project work.	
Requirements for successful completion: Practical grade	
Assessment methods applied for evaluating learning outcomes: Assessment based on the project work using a five-point grading scale.	
Recommended semester: Not tied to a specific semester.	
Prerequisites (if any):	
<p>Course Description</p> <p>The course focuses on the development and functional significance of the plant microbiome of horticultural products, with particular emphasis on postharvest processes. Students will gain an understanding of the microbial aspects of storage, packaging, and transportation conditions, the role of the microbiome in spoilage, and technologies aimed at extending the shelf life and enhancing the microbiological safety of horticultural products. Natural and biological preservation methods will also be introduced.</p>	
<p>Course Topics / Semester Schedule:</p> <ul style="list-style-type: none"> • Effects of postharvest processes on the structure and function of microbial communities • Microbiological effects of storage conditions • Interactions between microbial communities and spoilage microorganisms • Microbiological safety of horticultural products and food safety risks • Microbiome-based approaches to the prevention of postharvest spoilage • Natural antimicrobial solutions and combined preservation technologies • Application of rapid microbiological detection methods in horticultural products 	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	

<ul style="list-style-type: none"> • Spadaro, D., Droby, S., & Gullino, M. L. (eds.) (2021): Postharvest Pathology: Next Generation Solutions to Reducing Losses and Enhancing Safety. Springer, Cham, 1st ed., X + 202 p. ISBN 978-3-030-56529-9 (hardcover); ISBN 978-3-030-56530-5 (eBook). • Kumar, A. (ed.) (2022): Microbial Biocontrol: Food Security and Post Harvest Management. Volume 2. Springer, Cham, 1st ed., XI + 334 p. ISBN 978-3-030-87289-2 (eBook).
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<ul style="list-style-type: none"> • Adaskaveg, J. E., Förster, H., & Prusky, D. B. (eds.) (2022): Postharvest Pathology of Fruit and Nut Crops: Principles, Concepts, and Management Practices. APS Press, St. Paul, 1st ed., 606 p. ISBN 978-0-89054-667-3. • Thompson, A. K. (2015): Fruit and Vegetables: Harvesting, Handling and Storage. 3rd ed. Wiley-Blackwell, Chichester. ISBN 978-1-118-65404-0.
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>Knowledge</p> <ul style="list-style-type: none"> • Knowledge of the effects of postharvest processes and storage, packaging, and transportation conditions on microbial communities and the microbiological status of horticultural products. • Knowledge of the microbiological basis of microbial spoilage, postharvest diseases, and food safety risks. <p>Skills</p> <ul style="list-style-type: none"> • Ability to critically evaluate and synthesize scientific information on the microbiome of horticultural products and postharvest microbiology. • Ability to critically evaluate the applicability, advantages, and limitations of rapid microbiological detection and diagnostic methods. <p>Attitude</p> <ul style="list-style-type: none"> • Open to new scientific findings and technological solutions in postharvest microbiology and plant microbiome research. • Committed to solutions that take into account microbiological safety, quality preservation, and sustainability.