

Szent István University  
FACULTY OF HORTICULTURAL SCIENCE

**DOCTORAL SCHOOL OF HORTICULTURAL SCIENCES**

**A./ List of Ph.D. courses  
and other activities under the Credit Rules**

**B./ List of subjects of the complex exam**

Budapest

During the doctoral education, altogether 240 credits should be obtained.

Credits can be acquired by the following activities:

**by research and publication** of 145 credits – within this research activity should be a minimum of 115 credits, publication activity of at least 30 credits;

**by teaching** (of graduate students) activity for a maximum of 40 credits (less relevant for foreign students);

**by course completion** of a minimum of 40 credits;

### **Codes for the courses and activities**

#### Research and publication activities

1. semester	2. semester	3. semester	4. semester	5. semester	6. semester	7. semester	8. semester
3ZT14NBK13P	3ZT14NBK14P	3ZT14NBK15P	3ZT14NBK16P	3ZT14NBK17P	3ZT14NBK18P	3ZT14NBK24P	3ZT14NBK25P

#### Teaching activity

1. semester	2. semester	3. semester	4. semester	5. semester	6. semester	7. semester	8. semester
3ZT14NBK19P	3ZT14NBK20P	3ZT14NBK21P	3ZT14NBK22P	3ZT14NBK23P	3ZT14NBK26P	3ZT14NBK27P	3ZT14NBK28P

#### Study courses

*All courses are open for each student, however, you have to consider some rules indicated below.*

#### COMPULSORY COURSES

Compulsory courses for each student independent from research topic and thematic group

#### „GROUP-COMPULSORY” COURSES

For a student enrolled in a given research topic group, minimum one of the courses indicated here is compulsory

#### FREE CHOICE COURSES

Free choice courses should be chosen according to the research topic of the student after discussion with the supervisor.

*Titles and codes see in detail in the following tables and lists*

<b>List of study courses for the DSHS student</b>		
Course name	Course leader	credit
<b>SCHOOL COMPULSORY COURSES (A TOTAL OF 18 CREDITS)</b> (Courses to be completed for all students regardless of research topic group)		
Production biology of horticultural crops	Bernáth Jenő	6
Molecular biology in horticulture and application of results	Papp István	6
Statistical methods	Ladányi Márta	6
<b>RESEARCH GROUP COMPULSORY COURSES (6 CREDITS)</b> (For a student enrolled in a given research topic group, minimum one of the listed courses indicated here is compulsory)		
<b>1. Horticultural biology</b>		
Classical and molecular genetics	Benyóné György Zsuzsa	6
Actual problems of molecular biology and physiology in Horticulture	Papp István	
Soil Science and Soil-power-management in Horticulture	Bíró Borbála	6
<b>2. Ornamental plants and dendrology</b>		
Plant Propagation Biology and Technology development	Hrotkó Károly	6
Modern methods in floriculture and variety value research of ornamental plants	Tillyné Mándy Andrea	6
<b>3. Medicinal and aromatic plants</b>		
Medicinal and aromatic plants producing special active agents	Bernáth Jenő	6
<b>4. Fruit bearing plants</b>		
Methods and results of cultivar evaluation in pomology	Szalay László	6
<b>5. Viticulture and oenology</b>		
Biological bases of grape cultivation and variety evaluation	Bisztray György	6
Wine chemistry, biological principles of wine	Nyitrai Sárdy Diána	6
<b>6. Vegetables and cultivated fungi</b>		
Scientific bases of vegetable production	Geösel András	6
<b>7. Horticultural plant medicine</b>		
Plant Virology	Palkovics László	6
Arthropod taxonomy	Markó Viktor	6
<b>OPTIONAL COURSES (FREE CHOICE)</b> (Recommended courses may be taken depending on the research topic, in consultation with the supervisor)		
Theory and practice of fungal systematics and evolution	Rimóczi Imre	4
Phylogeography	Höhn Mária	4
Botanical nomenclature	Höhn Mária	4
In vitro propagation of ornamental plants	Tillyné Mándy Andrea	4
Soils/substrates and plant nutrition in isolated horticulture systems	Bíró Borbála	4
Rootstock usage, rootstock breeding and evaluation	Hrotkó Károly	4
Physio-ecological bases of introduction of medicinal and aromatic plants	Zámboriné N. Éva	4
Genetic background and breeding of medicinal and aromatic plants	Zámboriné N. Éva	4
Active compounds of medicinal plants	Pluhár Zsuzsanna	4
Biological and technical aspects of modern fruit storage	Simon Gergely	4
New growing elements of Integrated Fruit Production	Simon Gergely	4
Soilbiology, and soil health, plant-protecting soil science	Bíró Borbála	4
Drought resistance and water relations of grapevine	Bálo Borbála	4
The role of terroirs in viticulture	Bálo Borbála	4
Environmental control in vegetable production	Kappel Noémi	4
Intensive mushroom cultivation technologies	Geösel András	4
Ecological Bases of Pest Management	Markó Viktor	4

Environmentally-friendly management of horticultural pests	Fail József	4
Basics of Insect Anatomy	Haltrich Attila	4
Biofertilizers, soil conditioners and bioeffective solutions in horticulture	Bíró Borbála	4
Organic farming principles in scientific approach	Pusztai Péter	4
Climatology	Bozó László	4
Functional genomics	Lukács Noémi	4
Advances in sensory science	Kókai Zoltán	4
Light, fluorescent and confocal microscopy	Jäger Katalin	4
The ecology of nature based solutions	Csergő Anna Mária	4

## Study courses in detail

COURSES TO BE COMPLETED FOR ALL STUDENTS REGARDLESS OF RESEARCH THEMATIC GROUP

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
3ME13NAK01P	Production biology of horticultural crops	Bernáth Jenő	S	3+0	6	exam
3MN24NAK01P	Molecular biology in Horticulture and application of results	István Papp	S	2+1	6	exam
3MI09NAK01P	Statistical methods	Márta Ladányi		3+0	6	exam

**COURSES TO BE COMPLETED FOR ALL STUDENTS REGARDLESS OF RESEARCH THEMATIC GROUP**

### **3ME13NAK01P Production biology of horticultural crops**

(Dr. Jenő Bernáth professor emeritus)

The basic production biological aspects of production of horticultural crops. The effect of environmental factors, including edaphic and climatic ones, on the dry matter production, organ ratio and accumulation of the active agents of the plants. Methods, and tools of the measurements of environmental influences. Possibility and restrictions of application of production biological results in the cultivation practice.

### **3MN24NAK01P Molecular biology in horticulture and application of results**

(Dr. István Papp professor)

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.

### **3MI09NAK01P Statistical methods**

(Dr. Márta Ladányi associate professor)

During the semester, based on the knowledge the students have acquired in BSc/MSc level standard Biometrics and Statistics courses, some chapters of advanced statistics will be discussed with complex applications in computer lab in a practical way with many examples from agriculture that passed specially to the demands of PhD students, considering special problems of data management and documentation. We use the statistical software SPSS 20. At the end of the semester the students have to write a report applying at least one of the methods in their own special fields..

## 1. HORTICULTURAL BIOLOGY

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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<b>COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP</b>						
3GN18N BK01P	Classical and molecular genetics	Zsuzsanna György	W,S	3+0	6	exam
3MN24N BK02P	Actual problems of molecular biology and physiology in Horticulture	István Papp	W,S	3+0	6	oral examination
	Soil Science and Soil-power-management in Horticulture	Borbála Bíró	W, S	3+0	6	exam

<b>FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP</b>						
3NT20NB V23P	Theory and practice of fungal systematics and evolution	Imre Rimóczi	W,S	3+0	4	exam
3NT20NB V03P	Phylogeography	Mária Höhn	Spring	2+0	4	exam
3NT20NB V24P	Botanical nomenclature	Mária Höhn	Spring	2+0	4	exam

### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3GN18NBK01P Classical and molecular genetics**

(Dr. Zsuzsanna György associate professor)

The course deals with the most important concepts and processes of genetics. During the course students gain theoretical knowledge about the topics covered, like eucaryotic genom structure, genes, gene expression and regulation, cell cycle and division, Mendelian genetics, quantitative and qualitative traits and others according to the research interest of the students.

#### **3MN24NBK02P Actual problems of molecular biology and physiology in Horticulture**

(Dr. István Papp professor)

The course prepares students for learning new achievements in plant biology that are relevant in Horticultural practice. Nowadays problems of Horticultural production with feasible solutions and their potential impact are exposed, along with the underlying molecular biological background elaborated.

## **Soil Science and Soil-power-management in Horticulture**

(Dr. Borbala Biró, professor)

Soilbiological properties of soil-plant-microbe systems. Type of beneficial microorganisms and their role in plant growth and development. Impact of plants and plant communities in soil/rhizosphere microbiological properties. The rhizosphere effects and its development. Plant-microbial strategism. The impacts of soil-microorganisms and other soilbiota elements. The soil-food web and the various trophic levels in soil-plant systems. Sustainable and regenerative soil-power. Soilfertility, soil-resilience and soil-health parameters. Soil-microbial diversity. Dynamism of soilbiological properties among environmental stress-conditions. Interrelations among higher plants and microorganisms and the physiological characteristics. Stress adaptation of organisms and their applicability for recultivation, remediation practices. Short- and long-term effect of agricultural chemicals. Bio-/phyto-/rhizo-technologies in plant/soil/environmental protection and sustainable soil-power management.

### **FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP**

#### **Theory and practice of fungal systematics and evolution**

(Dr. Imre Rimóczi professor emeritus)

In the frame of the course the participants are getting to know the morphology based, traditional classification of fungi, and the new systematic concepts of modern molecular genetic studies; furthermore, they gain insight into the issues of fungal evolution. During the course we pay special attention to those fungal taxa which are connected to the horticultural science, and we discuss their practical importance.

#### **3NT20NBV03P Phylogeograph**

(Dr. Mária Höhn associate professor)

This lecture focuses on the molecular aspects of species' distribution patterns, dynamics, of populations and the genealogy and spatial distribution of genotypes. Molecular markers are useful tools to reveal lineage evolution, to test historical-biogeographical hypotheses, to identify phylogeographical relationships or to trace the origin and relationships of cultivated plants.

#### **Botanical nomenclature**

(Dr. Mária Höhn associate professor)

This lecture aims to give a basic knowledge about the nomenclatural rules in plants and fungi. How botanical names have to be applied correctly. In case when a new taxa is introduced, what are main applications and formalities that should be applied in case of natural and cultivated taxa? This is a practical guide that helps in doing taxonomical and nomenclatural revisions. The lectures provide recommendations for PhD students how to use correctly the nomenclatural rules in the time when molecular studies have reassessed plant systematics, taxonomy and nomenclature of taxa have to be revised. Should be emphasized that this topic is highly recommended for each PhD student that has to deal with taxonomical nomenclatural aspects of the species involved in his/her study. Papers published in the topic of nomenclatural revisions are highly appreciated by the scientific society.

## 2. ORNAMENTAL PLANTS AND DENDROLOGY

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP						
3DD02N BK01P	Plant Propagation Biology and Technology development	Károly Hrotkó	W,S	3+0	6	exam
3DD02N BK03P	Modern methods in floriculture and variety value research of ornamental plants	Andrea Tilly-Mándy	W,S	3+0	6	exam
"B" tárgyak összesen:						

FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP						
3DD02N BV25P	In vitro propagation of ornamental plants	Andrea Tilly-Mándy István Dániel Mosonyi Máté Ördögh	W,S	2+0	4	exam
3KT23N BV02P	Soils/substrates and plant nutrition in isolated horticulture systems	Borbála Bíró	W,S	2+0	4	exam
3DD02N BV06P	Rootstock usage, rootstock breeding and evaluation	Károly Hrotkó	W,S	2+0	4	exam

### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3DD02NBK01P Plant Propagation Biology and Technology development**

(Dr. Károly Hrotkó professor)

Biology of sexual reproduction, flowering biology. Seed biology, germination, emergence, seed and seedbed technology development. Biology of asexual reproduction of plants. Biology and anatomy of adventive organogenesis in vegetative propagation. Maintenance of stockplants, juvenility, stockplant pretreatments. Environmental condition requirements for vegetative propagation. Bioregulators in plant propagation. Grafting in plant propagation, anatomy and biology of graft union formation. Biology of rootstock/scion interactions. Rootstock usage in horticulture.

#### **3DD02NBK03P Modern methods in floriculture and variety value research of ornamental plants**

(Responsible lecturer: Assoc. Prof. Dr. Péter Honfi, Lecturer in English language: Assoc Prof. Dr. Andrea Tilly-Mándy)

Tendencies in Hungarian and international floriculture. Modern varieties of ornamental plants. Greenhouses, development of growing methods. Hydroculture of ornamental plants. Large-scale production of ornamental



plants, plug grower industries. Automation and modernization in open-field production. Energy saving ornamental plant cultures. Development of postharvest technologies.

### **FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP**

#### **3DD02NBV04P In vitro propagation of ornamental plants**

(dr. Andrea Tilly-Mándy associate professor)

Basis of biotechnology in ornamental plant production. The role of biotechnology in ornamental plant breeding and introduction of new cultivars. Phases, steps and requirements of micropropagation (pre-treatment, disinfection, culture media, light, temperature, acclimatization). Theoretical basis of micropropagation and tissue culture. Micropropagation technologies of ornamental plants, research methodology of technological development.

#### **3KT23NBV02P Soils/substrates and plant nutrition in isolated horticulture systems**

(Dr. Borbála Bíró professor)

Artificial soils and various substrates will be studied regarding of their common and distinct characteristics. Physical, chemical, colloid and biological properties among isolated circumstances. The pH and plant nutrition. Available and non-available nutrients. Nutrient-requirements and microbial interrelations during plant growth and development. Ion antagonistic properties among macro/meso/micro-nutrients. Specific interrelation among soil-plant systems at greenhouse and other isolated growth conditions. Alternative substrates and minerals for specific reasons of growing ornamentals, such as the organic materials (bark, coconut fibers, composts..etc.). Possibilities of sustainable plant nutrition and way of intensive growth conditions. Artificial soils and substrates at specific environments. Environmental stress conditions in urbanised and technogenous areas. Vertical horticulture, Substrates in the circular economy.

#### **3DD02NBV06P Rootstock usage, rootstock breeding and evaluation**

(Dr. Károly Hrotkó professor)

Rootstock usage for woody plants. History and development of rootstock research. Grafting in plant propagation, anatomy and biology of graft union formation. Biology of rootstock/scion interactions, importance in agronomy. Graft compatibility/incompatibility. Methodology of rootstock breeding and evaluation. Rootstocks for fruit trees and woody ornamentals.

### 3. MEDICINAL AND AROMATIC PLANTS

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP						
3ME13N BK02P	Medicinal and aromatic plants producing special active agents	Jenő Bernáth	W,S	3+0	6	exam

FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP						
3ME13N BV04P	Physio-ecological bases of introduction of medicinal and aromatic plants	Zámboriné Németh Éva	W,S	2+0	4	exam
3ME13N BV06P	Genetic background and breeding of medicinal and aromatic plants	Zámboriné Németh Éva	W,S	2+0	4	exam
3ME13N BV25P	Active compounds of medicinal plants	Zsuzsanna Pluhár	W,S	2+0	4	exam

#### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

##### **3ME13NBK02P Medicinal and aromatic plants producing special active agents**

(Dr. Jenő Bernáth professor emeritus)

The participants get information on the special medicinal and aromatic plants accumulating important active agents, which have restricted importance at present, but their utilization would increase in the future. These species were not included into the basic courses. At the same time the participants of the course get information on the up to date tendencies, efforts and methods which are important to the real evaluation of the biological effectiveness of the new special compounds. The up to date pre- and post-harvest processing of medicinal and aromatic plants is a part of the course to optimize the isolation of active agents.

#### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

##### **3ME13NBV04P Physio-ecological bases of introduction of medicinal and aromatic plants**

(Zámboriné dr. Németh Éva professor)

Development of agrotechnology for plants which have been obtained until now from natural habitats seems to be a worldwide trend. The course focuses on this need and presents the most important phases and tasks of this work. They get numerous examples from successful and less successful introduction trials internationally and face the critical steps. To course requirements belongs preparation of an individual study based on literature data.

### **3ME13NBV06P Genetic background and breeding of medicinal and aromatic plants**

(Zámboriné dr. Németh Éva professor)

In the frame of this course the students are informed about the significance of the biological background (genotype) of drug production. The topic includes the most important goals and achievements of the recent period in medicinal and aromatic plant breeding. Aspects like molecular markers, documentation of genetic identity and maintenance of varieties, phenotypic manifestation of the genetic traits are also discussed. Special methods are presented by case studies. The students have to elaborate an own presentation of a special topic on MAP breeding.

### **3ME13NBV25P Active compounds of medicinal plants**

(Dr. Zsuzsanna Pluhár professor)

The course provide relevant information on the active compounds of medicinal and aromatic plants in biosynthetic context. The most important genetic and environmental factors influencing the biosynthesis and accumulation of special molecules are demonstrated. Biological, ecological as well as technological processes affecting content and composition of active substances are presented on model species. A review of the recent literature available is also included in the teaching programme as a personalized requirement.

#### 4. FRUIT BEARING PLANTS

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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##### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

3GY15N BK25P	Methods and results of cultivar evaluation in pomology	László Szalay	W	2+2	6	exam
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##### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

3GY15N BV26P	Biological and technical aspects of modern fruit storage	Gergely Simon	W, S	2+0	4	exam
3GY15N BK27P	New production elements of Integrated Fruit Production	Gergely Simon	W, S	2+1	4	exam
3KT23N BK10P	Soil biology, and soil health, plant-protecting soil science	Borbála Bíró	W, S	2+0	4	exam

##### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3GY15NBK25P Methods and results of cultivar evaluation in pomology**

(László Szalay PhD associate professor)

In this subject we deal with the field and laboratory methods of fruit cultivar evaluation. This field of research belongs to classic pomology, which remains to be of great importance even today from the aspects of phenology, morphology as well as agronomy. The pomologist, adopting various methodologies and relying on numerous specific skills, is called upon to essentially carry out the role of synthesis, integrating and finalizing all the observations and data collected towards a single aim: to characterise the cultivar in its complexity.

Individual project: description of new cultivars of a selected fruit species based on the international scientific literature.

##### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3GY15NBV26P Biological and technical aspects of modern fruit storage**

(Dr. Gergely Simon PhD associate professor)

The fruits have higher market price out of their main ripening season. Special fruit storage technologies are needed for preserving the quality and the economically storage. Subjects of the lectures are the following: development of the fruits storage research work and technologies in Hungary and in abroad; biological, physiological and economy researches. Losses during the storage period (fruit weight, storage disorders a pathogen infection, quality losses); environmental and growing technological effect on the storage; storage conditions and technologies (NA, CA, ULO); special storage conditions and technologies of different fruit

species. Effect of fruit growing technology elements (nutrition, irrigation, pruning and fruit thinning and plant protection) on physiological status and storage of fruits.

### **3GY15NBK27P New production elements of Integrated Fruit Production**

(Dr. Gergely Simon PhD, associate professor)

Integrated Fruit Production (IFP) technology is generally applied all over the world. Over the appropriate site and cultivar selection the right growing technology is also playing decisive role in the economical fruit production. Subjects of the lectures are the following: environmental conditions from the aspect of IFP; intensive training systems and growing technology elements of IFP and their theoretical and physiological background. Modern fruit growing technologies, technical developments of leader European fruit producer countries are presented.

Students have individual essay and planning projects on IFP subject.

### **3KT23NBK10P Soil biology, and soil health, plant-protecting soil science**

(Dr. Borbála Bíró professor)

The interrelation among soil-physical, -chemical- and -biological properties. The soil-fertility and the soil-health and their interactions. Soil-health parameters and indication. Monitoring of soil-biological status. The soil food web (SFW) and their organisms. Role of SFW in plant-protection. Beneficial and deleterious organisms in the soil-plant systems. Survival mechanisms and strategies in soil. The „quorum sensing” and the communication among plants and soilbiota. Secondary metabolics for communication. Antagonistic behaviour and antagonistic materials. Agrochemicals and their general and specific effects. How to manage the development of suppressive soils? Why became a soil to be receptive for soil-borne plant pathogens? The development and treatments of soil-replant disease symptoms at fruit-bearing trees.

## 5. VITICULTURE AND OENOLOGY

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP						
3SZ22NB K01P	Biological bases of grape cultivation and variety evaluation	György Bisztray	W, S	3+0	6	exam
1BT33NB K01P	Winechemistry, biological principles of wine	Diána Nyitrainé Sárdy	W, S	3+0	6	exam

FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP						
3SZ22NB V03P	Drought resistance and water relations of grapevine	Borbála Bálo	W, S	2+0	4	exam
3SZ22NB V25P	The role of terroirs in viticulture	Borbála Bálo	W, S	2+0	4	exam

### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3SZ22NBK01P Biological bases of grape cultivation and variety evaluation**

(Dr. György Dénes Bisztray professor)

Systematics, characteristics, relatives of *Vitis sp.* Morphology and histology of the grapevine: morphology and histology of the seedling and the plant obtained by generative or vegetative propagation, the root system, the stem, and stem lateral organs (leave, shoot, inflorescence and flowers, tendril, cluster) morphology and histological description. Cytological characteristics and developmental biology of the grapevine. The biological bases of biotic and abiotic stress resistance.

#### **1BT33NBK01P Winechemistry, biological principles of wine**

(Dr. Diána Nyitrainé Sárdy associate professor)

The chemical composition of wine, special compounds / polyphenols, biogenic amines, etc./ Physiologically active compounds in wine, the physiological effect of wine. Special analytical methods in wine industry.

### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3SZ22NBV03P Drought resistance and water relations of grapevine**

(Dr. Borbála Bálo associate professor)

Facing the challenges of climate change in Hungary. Biological background of grapevine drought resistance. Adaptation strategies of various grapevine cultivars. Measuring technics of plant water supply (soil, plant). Effect of water supply on grape quality. Technologies of water saving and irrigation technics.

**3SZ22NBV25P** The role of terroirs in viticulture  
(Dr. Borbála Bálo associate professor)

Role of edaphic and climatic characteristics in terroir expression. Slope, exposition, elevation factors. Using geographical information system (GIS) in terroir characterization. Choosing the adequate viticultural technics for the best terroir expression. Factors of grape and wine uniqueness..

## 6. VEGETABLES AND CULTIVATED FUNGI

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

3ZT14NB K01P	Scientific bases of vegetable production	András Geösel	W, S	3+0	6	exam
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### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

3ZT14NB V05P	Environmental control in vegetable production	Noémi Kappel	W, S	2+0	4	exam
3ZT14NB K03P	Intensive mushroom cultivation technologies	András Geösel	W, S	3+0	4	exam
3KT23N BV06P	Biofertilizers, soil conditioners and bioeffective solutions in horticulture	Borbála Bíró	W, S	2+0	4	exam

### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3ZT14NBK01P Scientific bases of vegetable production**

(Dr. András Geösel, associate professor)

According to the PhD student knowledge the nutritional and economic impact of vegetable production, tendencies in consumption will be discussed. The domestic importance of production, regions, specific products will be demonstrated. Based on latest scientific results the most important agro-phytotechnical, agrochemical and phytosanitary activities, packaging, handling, storage will be discussed. Besides modern open field and forced technologies the biotechnological aspects of vegetable production is demonstrated.

### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3ZT14NBV05P Environmental control in vegetable production**

(Dr. Noémi Kappel associate professor)

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<sub>2</sub> 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.

#### **3ZT14NBK03P Intensive mushroom cultivation technologies**

(Dr. Geösel András associate professor)

Topics to be discussed:



- Biological background and requirements for mushroom cultivation
- Global trends and tendencies of mushroom cultivation technologies
- Research and development in the mushroom sector
- Tasks for the future: weak points in the cultivation
- The global network in the mushroom business (from spawn to fruit body)
- Mushroom breeding and novel varieties
- Post-harvest, process, packaging and marketing
- Besides food production: other usage of fungi

### **3KT23NBV06P Biofertilizers, soil conditioners and bioeffective solutions in horticulture**

(Dr. Borbála Bíró professor)

Biological, ecosystem way of thinking in horticultural practices. The biological solutions in plant nutrition and in plant protection. Biotic and abiotic bioeffectors. The soil-characteristics as initial parameter in plant growth and development. Plant-soil-plant conditioner products (PSP) as biofertilizers. Plant protecting products (PPP) as biopesticides, or as biological control agents. The soil-structure improving products (SSP). Biological composition of biofertilizers (fungi and bacteria, heterotrophs and oligotrophs). Various strategies of soil-plant-microbe-environment systems. The r, K and L-strategies. Monovalent or multivalent microbial inoculums. The „tripartite” systems. Surviving ability of microbes in various carriers. National and international biofertilizers. Registration of microbial inoculums. Predicted and real effects of inoculums. Indigenous and antagonistic microbes in soils. Biotic and abiotic environmental „stress” conditions. Biomonitoring of microbial inoculums during plant-physiological status and vegetation periods. Trustability of biofertilizers in soil-fertility and soil-functioning.

## 7. HORTICULTURAL PLANT MEDICINE

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
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### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

3NK06N BK01P	Plant Virology	László Palkovics	W	3+0	6	exam
3RT07N BK01P	Arthropod taxonomy	Viktor Markó	W	3+0	6	exam

### FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

3RT07N BV02P	Basics of Insect Anatomy	Attila Haltrich	W	3+0	4	exam
3RT07N BV03P	Ecological Bases of Pest Management	Viktor Markó	W, S	3+0	4	exam
3RT07N BK04P	Environmentally-friendly management of horticultural pests	József Fail	W, S	3+0	4	exam

### COURSES TO BE COMPLETED FOR STUDENTS IN THIS THEMATIC GROUP

#### **3NK06NBK01P Plant Virology**

(Dr. László Palkovics profesor)

For more than a century, plant viruses are known to reduce the yield and quality of different crops. At present, approximately thousand different plant virus species have been described. The offered course will mediate a detailed overview about the present knowledge of conventional and molecular aspects of plant virology. The lecture starts with the history of plant virology, discovery of viruses, principles of the architecture of their particles and genome organisation, imparting the knowledge, how the viral genome replicates, moves in the plant, thereby interacting with the host genome and spreads from host to host with the help of different vector organisms. This is followed by lectures on virus-like agents such as viroids and satellites, virus detection and control. Possible protection strategies will be discussed as well as topics of molecular virology

#### **3RT07NBK01P Arthropod taxonomy**

(Dr. Viktor Markó professor)

A compulsory course for students in the Entomology subgroup of the Horticultural Plant Medicine scientific field. It provides deeper insight into current arthropod taxonomy. The taxonomy and external anatomy of Arthropoda is discussed with main emphasis on Hexapoda. Students learn the biology of arthropods and their ecological importance. The acquired knowledge is a basis for applied research in the field of agricultural pest management.

## FREE CHOICE COURSES SUGGESTED FOR STUDENTS IN THIS THEMATIC GROUP

### **3RT07NBV02P Basics of Insect Anatomy**

(Dr. Attila Haltrich associate professor)

Within this course we discuss the anatomy of different insect orders. Determine the structure of the appendages and sensory organs on the head, thorax and abdomen. The nervous-, circulatory- and respiratory-system, the digestive tract and other internal structures are compared in different insect taxa. We lay special emphasis on insect reproduction, embryonic- and post-embryonic development. Discuss the distinctive features and lifestyle of each family within insect orders of great importance from the aspect of horticultural plant protection.

### **3RT07NBV03P Ecological Bases of Pest Management**

(Dr. Viktor Markó associate professor)

This course aims to provide an integrated understanding of some key issues in the ecology of pest management. Fundamental concepts of applied ecology are discussed to address challenges in managing insects. Main topics: (1) Ecological characteristics of insect pests, (2) Integrated pest management (IPM), (3) A brief history of IPM, (4) Pesticides: useful and harmful effects, (5) Ecological principles of biological control, (6) Ecology of host-plant resistance to insects, (7) Pest management in organic agriculture, (7) Environmental pest management. After successful completion of this course, the student is expected to be able to: explain why some insect species become pests; explain what kinds of ecologically based pest management strategies are available to control insect pests; recognize the benefits and ecological hazards associated with use of pesticides.

### **3RT07NBK04P Environmentally-friendly management of horticultural pests**

(Dr. József Fail associate profesor)

The main focus of this course is the advantages and limitations of environmentally-friendly management techniques of key horticultural pests. It builds on the already acquired knowledge of students about agro technical and other practices that lay the foundations for their use in pest control. In the frame of this course students prepare a case study about the different management techniques of a key horticultural pest and model their effect on the entire pest assemblage of the given crop.

## RESEARCH TOPIC GROUP RELATED OPTIONAL SUBJECTS

Code	Title of course	Lecturer	Semester	Number of lectures	Credit	Requirement
3OG55NCV01P	Organic farming principles in scientific approach	Péter Pusztai	S	2+0	4	seminar note
3KT23NCV07P	Climatology	László Bozó	W	2+0	4	exam
3MN24NBV03P	Functional genomics	Lukács Noémi	W	2+0	4	exam
ETPDNAAT13C	Advances in sensory science	Kókai Zoltán	S	2+0	4	exam
3GN18NCS07P	Light, fluorescent and confocal microscopy	Jäger Katalin	S	2+1	4	exam
	The ecology of nature based solutions	Csergő Anna Mária	W, S	1+1	4	seminar note

## RESEARCH TOPIC GROUP RELATED OPTIONAL SUBJECTS

Recommended subjects may be taken depending on the research topic, in consultation with the supervisor.

**3OG55NCV01P Organic farming principles in scientific approach**  
(Dr. Péter Pusztai associate professor)

Organic farming is a special sequence of the food production and in overall agricultural activities. Scientific approach is necessary to ensure that organic product is healthy, safe, and provide social and ecological well-being. However, scientific knowledge alone is not sufficient without practical experience. Organic agriculture should prevent all the risks by adopting conventional technologies with no deep and essential investigation. The goal of this course is to introduce PhD students into theory and practice. Students have to be prepared to understand and use the legislation of EU on organic sector and make scientific valid decision on all fields of organic agriculture.

**3KT23NCV07P Climatology**  
(Dr. László Bozó professor)

Definition of climate, subjects and methods. Monitoring and observation of atmospheric phenomena including state-of-the-art technologies. Climatological potential: sources and derivation of climatological data. Ecological aspects of climate. Climate risks (drying, drought, precipitation, freeze) and their temporal and spatial variation. Climate change: its possible reasons. Anthropogenic effects on the composition of the atmosphere.

Climatological classification. Climate of Europe and Hungary. Definition of micro- and mezo-climate and their methodology.

### **3MN24NBV03P Functional genomics**

(Dr. Noémi Lukács professor emerita)

The aim of functional genomics studies is to understand the complex relationship between genotype and phenotype on a global (genome-wide) scale. Studies investigate a range of processes such as transcription, translation and epigenetic regulation, in an attempt to answer relevant biological and practical questions. Topical questions in horticulture, for example, may be the interaction and regulation of genes/proteins to achieve resistance to different stressors, to produce high yields, certain quality or phenotype, etc.

A key characteristic of functional genomics studies is their genome-wide approach to these questions, generally involving high-throughput methods rather than a more traditional “gene-by-gene” approach. The lessons will cover the methods used in transcriptomic, proteomics, metabolomic and phenomic studies and discuss possible applications of these approaches in horticulture.

### **ETPDNAAT13C Advances in sensory science**

(Dr. Zoltán Kókai associate professor)

Sensory analysis is an integrated part in the quality management of food products. Novel techniques are widespread in the international literature and also in the industry. The goal of this course is to introduce these methodologies to the PhD students in theory and practice. The theoretical part of the training includes the overview of the sensory ISO standards and the principles of the advanced testing methods. In the practical part students implement sensory tests in a computerized environment. Participants of the course will be qualified on the basis of their performance in their project work on a specified field. Maximum number of participants for this course: 16 students.

### **3GN18NCS07P Light, fluorescent and confocal microscopy**

(Dr. Katalin Jäger, senior research associate)

Description: The course provides assistance in selecting the microscope type and microscope technique best suited for cellular and histological examinations to solve a given scientific problem. It introduces the history of microscopy and the development of modern microscopic techniques. The course provides an introduction to the essential grounding in the basic principles of optical microscopy. It describes the fixation, embedding and sectioning of biological samples, and the methods of histochemical labeling. It gives insight into the evaluation of visual and recorded images and introduces image processing methods.

### **The ecology of nature based solutions**

(Dr. Anna Mária Csergő, associate professor)

The accelerating ecological crisis presses scientists to develop efficient, nature-based solutions that enable the simultaneous preservation of ecological processes and of human well-being. The course will expose students to case studies of ecological research at the forefront of conservation, sustainable use and restoration of natural ecosystems and cultural landscapes. Students will acquire cutting-edge ecology theory and practice, and will be encouraged to find innovative solutions oriented towards the sustainable use of natural resources, by using multidisciplinary approaches.

## TOPICS OF THE COMPLEX EXAM

Each student has to fulfill a so called „Complex exam” which is due after the 4th semester during the study. With this successful exam the period of *education and research* is finished and the *research and thesis* period will start. During the exam the educational achievements and the stage of the research is being evaluated by the committee.

Topic	
Code	Title
3ME13PHDSZIG01	Plant physiology
3ME13PHDSZIG02	Plant molecular biology
3ME13PHDSZIG03	Plant genetics
3ME13PHDSZIG04	Classical and molecular plant breeding
3ME13PHDSZIG05	Mushroom taxonomy
3ME13PHDSZIG06	Mushroom ecology and cönology
3ME13PHDSZIG07	Community ecology and population genetics
3ME13PHDSZIG08	Production biology and environmental management of herbaceous ornamental plants
3ME13PHDSZIG09	Biological bases of cultivation and utilisation of herbaceous ornamental plants
3ME13PHDSZIG10	Genetic and biological bases of the evaluation of ornamental plants' varieties
3ME13PHDSZIG11	Growth and reproduction biology and technology systems of woody plants
3ME13PHDSZIG12	Scientific bases of the environmental benefits of ornamental plants
3ME13PHDSZIG13	Biological and technological basics of post-harvesting of ornamental plants
3ME13PHDSZIG14	Active compounds of medicinal and aromatic plants
3ME13PHDSZIG15	Environmental factors influencing the production of medicinal and aromatic plants
3ME13PHDSZIG16	Natural and artificial (agrarian) systems producing special materials and their optimization
3ME13PHDSZIG17	Genetic issues of herbs, variety production
3ME13PHDSZIG18	Post-harvest and secondary processing of herbs
3ME13PHDSZIG19	Variety evaluation and practical pomology

3ME13PHDSZIG20	Fruit breeding
3ME13PHDSZIG21	Cultivation systems and cultivation technology for fruit production
3ME13PHDSZIG22	The biology of flowering and fertility of fruit bearing plants, association of varieties
3ME13PHDSZIG23	Biological and technological aspects of post-harvest operations of fruits
3ME13PHDSZIG24	Biological basics of vine production
3ME13PHDSZIG25	Vine variety research, grape breeding, propagation
3ME13PHDSZIG26	The role of production area in the nutrition and water management of grapes
3ME13PHDSZIG27	Modern cultivation trends in viticulture
3ME13PHDSZIG28	Wine chemistry, the biochemical basis of wine making
3ME13PHDSZIG29	The biological bases of vegetable production
3ME13PHDSZIG30	Utilization of indoor systems
3ME13PHDSZIG31	Intensive mushroom cultivation technologies
3ME13PHDSZIG32	Plant protection virology and bacteriology
3ME13PHDSZIG33	Mycology of plant protection
3ME13PHDSZIG34	Nematology of plant protection
3ME13PHDSZIG35	Plant protection entomology
3ME13PHDSZIG36	Plant protection acarology
3ME13PHDSZIG37	Weed biology, weed control