

## Applied plant nutrition (146051)

### Nositelji predmeta

[izv. prof. dr. sc. Marko Petek](#), prof. dr. sc. Zed Rengel

### Opis predmeta

To give applicable and advanced knowledge on the biological and chemical processes affecting plant availability, function and losses of nutrients applied in mineral and organic fertilizers into soil as well as amendments used in agricultural and horticultural crop production. With this knowledge students become able to evaluate soil nutrient status and crop nutrient demand, to diagnose nutrient deficiencies of agricultural and horticultural crops, and to plan fertilisation strategies at the crop and farm level.

ECTS: **6.00**

Engleski jezik: **R2**

E-učenje: **R2**

**Sati nastave: 60**

Predavanja: 34

Laboratorijske vježbe: 16

Seminar: 8

Terenske vježbe: 2

#### Izvođač predavanja

- [izv. prof. dr. sc. Marko Petek](#)
- prof. dr. sc. Zed Rengel

#### Izvođač vježbi

- [izv. prof. dr. sc. Tomislav Karažija](#)
- [izv. prof. dr. sc. Marko Petek](#)

#### Izvođač seminara

- [izv. prof. dr. sc. Marko Petek](#)

### Ocjenjivanje

Dovoljan (2): 60-70 %

Dobar (3): 71-80 %

Vrlo dobar (4): 81-90 %

Izvrstan (5): 91-100 %

### Vrsta predmeta

- Graduate studies / [Environment, agriculture and resource management](#) (Obvezni predmet, 2. semestar, 1. godina)

## Opće kompetencije

To give applicable and advanced knowledge on the biological and chemical processes affecting plant availability, function and losses of nutrients applied in mineral and organic fertilizers into soil as well as amendments used in agricultural and horticultural crop production. With this knowledge students become able to evaluate soil nutrient status and crop nutrient demand, to diagnose nutrient deficiencies of agricultural and horticultural crops, and to plan fertilization strategies at the crop and farm level.

## Oblici nastave

- Lectures
- Laboratory practice/exercises  
As part of the laboratory exercises basic chemical analysis of soil are performed for the purpose of writing the recommendations for fertilization of horticultural plants.
- Field work  
As a part of field work soil sampling in the field is performed.
- Seminars  
Seminar is independent work of each student (or group(s) of students) where students (as a team) elaborate issues related to plant nutrition and propose practical solutions.

## Ishodi učenja i način provjere

Ishod učenja	Način provjere
Evaluate importance of nutrient status and demand of soil, other growing media and crops, based on soil and plant analyses,	Participating in the discussions, partial exam, oral exam, final exam.
Diagnose nutrient deficiency symptoms in common agricultural and horticultural crop plants,	Participating in the discussions, partial exam, oral exam, final exam.
Apply advanced principles to fertilization strategy planning, taking into account soil nutrient mineralization and optimal use of available organic manures (stable manure, compost, green manures),	Participating in the discussions, partial exam, oral exam, final exam.
Discuss the role of fertilization as well as mineral and organic manures on agriculture sustainability issues,	Participating in the discussions, partial exam, oral exam, final exam.
Understand the importance of soil and plant sampling as well as analyzing.	Participating in the discussions, partial exam, oral exam, final exam.
Understand the basic methods relevant to plant and soil analyses,	Participating in the discussions, partial exam, oral exam, final exam.
Prepare reports on the basis of analytical results.	Participating in the discussions, partial exam, oral exam, final exam.

## Način rada

### Obveze nastavnika

Teachers' obligations are to teach students and present in a simple and understandable way educational course content. To assess the level to which students have adopted educational objectives and achieved the expected learning outcomes. To evaluate the learning outcomes of students through the set of evaluation criteria set out in grading system (grades insufficient (1) to excellent (5)), that is compatible with the ECTS system, by using interrogation techniques in the form of the questions through written and oral evaluation.

### Obveze studenta

Students' main obligation is regularly attend classes. Further, actively participate in discussions, ask and answer questions in lectures and seminars. Independently solve tasks of theoretical and practical problems. Seminar papers must be prepared and presented individually or in groups and actively participate in the discussion.

## Polaganje ispita

Elementi praćenja	Maksimalno bodova ili udio u ocjeni	Bodovna skala ocjena	Ocjena	Broj sati izravne nastave	Ukupni broj sati rada prosječnog studenta	ECTS bodovi
Class attendance (lectures + excercises) Actively participation in class	10			58	45	1
Partial exam 1 (PE1)	20	0-59 % 60-70 % 71-80 % 81-90 % 91-100 %	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)		25	1
Partial exam 2 (PE2)	20	0-59 % 60-70 % 71-80 % 81-90 % 91-100 %	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)		25	1
Seminar (S)	20				25	1
Oral exam (OE)	30	0-59 % 60-70 % 71-80 % 81-90 % 91-100 %	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)			2
Correction exam*	(20%)*	0-59 % 60-70 % 71-80 % 81-90 % 91-100 %	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)		(25)	(1)

Elementi praćenja	Maksimalno bodova ili udio u ocjeni	Bodovna skala ocjena	Ocjena	Broj sati izravne nastave	Ukupni broj sati rada prosječnog studenta	ECTS bodovi
Final exam (FE)**	100**	0-59 % 60-70 % 71-80 % 81-90 % 91-100 %	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)		60	6
Total	100 %	PE1+PE2+S+OE /4 or FE		58	180	6

Elementi praćenja	Opis	Rok	Nadoknada
Class attendance (lectures + excercises) Actively participation in class	Active participation in class may raise the grade		
Seminar (S)	Grading scale depends on the presented knowledge and writing skills		
Correction exam*	* The student has the possibility to fix a grade of one partial exam, or to take one partial exam in case he was not able to access during the regular partial exams' period		
Final exam (FE)**	** If the student does not pass the course through partial exams, take the final exam in the exam period consisting of a written and oral exam		
Partial exam 2 (PE2)	Exam covers microelements, elements with toxic effects, fertilizers and fertilization, soil and plant analysis.	14th week	Possible through separate exam writting (2ECTS)
Seminar (S)	Students select a topic related to course, make presentation, present and answer to questions.	15th week	Possible with agreement (1 ECTS)
Correction exam		15th week	
Oral exam (OE)	Oral evaluation.	Exam period	
Final exam (FE)**	Evaluation of the theoretical acquired knowledge, analytical skills, critical thinking and, identifying and solving of practical problems.	Exam period	

## Tjedni plan nastave

1. The role of plant nutrition in modern agricultural production; Biogenic elements, classification; Macroelements 1. L - Role of plant nutrition on environmental impact and effect on the overall health of plants, yield and food quality. Macro and microelements, properties and role. Nitrogen and phosphorus in the soil and plant.
2. Macroelements 2. - Distribution and behavior of micronutrients in soil 1. L+Pe-L - Potassium, calcium, magnesium and sulfur in the soil and plant. Organic and inorganic equilibria, adsorption and transport in soil (iron, zinc, copper).
3. Distribution and behavior of micronutrients in soil 1.; Distribution and behavior of micronutrients in soil 2. Pe-L - Organic and inorganic equilibria, adsorption and transport in soil (iron, zinc, copper). Organic and inorganic equilibria, adsorption and transport in soil (manganese, molybdenum, boron).
4. Rhizosphere chemistry relevant for micronutrient uptake by plants. Pe-L - Factors that influence the availability of microelements.
5. Heavy metals in plants. Media for plant growth. Factors affecting the nutrients uptake. L - Accumulation of heavy metals in plants and maximum permissible concentrations in food. Growing plants on soil, substrates and hydroponics. Effect of water pH, temperature, etc. to receive nutrients.
6. Nutrient's forms. Nutrients inflow to the roots. The entry of nutrients into the root. Types of plant nutrition (through soil and foliar nutrition). L - Ions, chelates, mass flow, diffusion flux, ion exchange. Passive and active movement. Moving across biological membranes. Theories of the entry of nutrients into the cell. Factors affecting the availability of plant nutrients in the soil (the role of plant roots and soil). The mechanism of intake over aboveground organs (leaf and stem) and the factors that affect it.
7. Classification of fertilizers, fertilization. Legislation. Organic fertilizers and fertilization. L - Organic and mineral fertilizers. Fertilization - preventive, curative. Legislation related to fertilizers in Croatia and the EU. Types and forms of organic fertilizers.
8. Mineral fertilizers and fertilization. Foliar fertilizers and nutrient solutions. L - Types and forms of mineral fertilizers. Concentrations for the foliar application and the nutrient solution.
9. Soil fertility control. Soil sampling. Lab+F - Guidelines of soil sampling for different plant species. Soil sampling in the field.
10. Determination of physiologically active phosphorus and potassium in the soil. Determination of total nitrogen in the soil and plant material. Lab - Determination of physiologically active phosphorus and potassium in the soil. Determination of total nitrogen in the soil and plant material.
11. Determination of soil pH and physiologically active lime in the soil. Foliar analysis. Lab - Determination of soil pH and physiologically active lime in the soil. Guidelines of plant material sampling for different plant species.
12. Determination of nitrate in plant material. Determination of phosphorus and potassium in plant material. Lab - Determination of nitrate in plant material. Determination of phosphorus and potassium in plant material.
13. Preparation and analysis of nutrient solution. Interpretation of laboratory findings and recommendations for fertilization. Lab+L - Preparation and analysis of nutrient solution. Interpretation based on the results of chemical analysis of soil, foliar analysis, nutrient concentrations presented yields and planned yield.
14. Seminar. S - Making recommendations for fertilization based on chemical analysis of soil and the needs of plant species. Oral presentation of seminar.
15. Seminar. Written exam. S-WE - Making recommendations for fertilization based on chemical analysis of soil and the needs of plant species. Oral presentation of seminar.

## Obvezna literatura

1. Mengel K., Kirkby E.A., Kosegarten H., Appel T. (2001) Principles of Plant Nutrition, 5th edition, Boston
2. Marschner H. (1995) Mineral Nutrition of Higher Plants, Academic Press. London, San Diego, New York, Boston, Sydney, Tokyo, Toronto.
3. Finck A. (1982) Fertilizers and Fertilization, Introduction and Practical Guide to Crop Fertilization Weinheim, Deerfield beach, Florida Basel.
4. Bergmann W. (1992) Nutritional Disorders of Plants, Development, Visual and Analytical Diagnosis

## Preporučena literatura

1. J. Keller, H.K. Mohring (1966): Die Düngung in der gärtnerischen Praxis, Paul Parley, Hamburg.
2. Phillip J. Craul (1992): Urban Soil in Landscape Design, Jon Wiley and Sons, INC, New York.
3. K. Mengel, E.A. Kirkby, H. Kosegarten, T. Appel (2001): Principles of Plant Nutrition, 5th edition, Boston.
4. W. Bergmann (1992): Nutritional Disorders of Plants, Gustav Fisher Verlag Jena, Stuttgart.
5. Fardossi, A. Baumgarten, K. Bauer (2003): Richtlinien für die Sachgerechte Düngung im Weinbau, Wien.
6. Finck (1982): Fertilizers and Fertilization, Introduction and Practical Guide to Crop Fertilization, Basel.

## Sličan predmet na srodnim sveučilištima

- Crop physiology and Nutrition, University of Hohenheim.
- Biochemistry in Plant Nutrition, Justus-Liebig-University of Giesen.
- Plant Nutrition and Nutrient Management, University of Nebraska-Lincoln.