

Course Unit	Microbial association and biofertilizers	Field of study	Biology and biochemistry
Master in	Biotechnological Engineering	School	School of Agriculture
Academic Year	2023/2024	Year of study	1
Type	Semestral	Semester	1
Workload (hours)	135	Contact hours	T - TP - PL - TC - S - E - OT - O -
		Level	2-1
		Code	5010-784-1101-00-23
		ECTS credits	5.0

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Anabela Rodrigues Lourenço Martins, Isabel Cristina Sousa Rodrigues, Margarida Maria Pereira Arrobas Rodrigues

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Understand the basic soil-plant relationships and their effect on the bioavailability of nutrients.
2. Know the biology of the rhizosphere and microbial associations.
3. Know the current state of knowledge concerning the rhizosphere microorganisms in the various aspects related to agronomy, genetics, physiology and biochemistry.
4. Know the several groups of rhizosphere microorganisms with importance as biofertilizers.
5. Apply the technologies developed for the use of rhizosphere microorganisms in sustainable agriculture

### Prerequisites

Before the course unit the learner is expected to be able to:  
Not Applied

### Course contents

Soil properties that affect the microbial activity. Cycles of nitrogen and phosphorus in the soil and role of these nutrients to plants. Rhizosphere Biology. Rhizosphere soil. Symbiotic nitrogen fixing forms in leguminous plants and in non-leguminous trees; non-symbiotic (free-living, associative or endophytic) N<sub>2</sub>-fixing forms. Mechanism of biological nitrogen fixation in leguminous plants. Phosphate solubilisation. Endo- and ectomycorrhizae. Biofertilizers. Organisms with biofertilizer value.

### Course contents (extended version)

1. Soil-plant relations
  - Soil concept and constituents
  - Physical, chemical and biological soil properties
  - Soil quality indicators
2. N and P nutrient cycles
  - Importance of N in the terrestrial globe. Role in ecosystems
  - Transformation of nitrogen in ecosystems
  - Importance of P in the terrestrial globe. Role in ecosystems
  - Phosphorus transformation in ecosystems
3. Rhizosphere biology
  - Endorhizosphere, rhizoplane and ectorhizosphere
  - Root Exudates: composition, roles and factors affecting root exudates
  - Rhizosphere-inhabiting microflora
  - Plant-microbe interactions in the rhizosphere (beneficial, neutral, detrimental)
  - Role of rhizosphere microorganisms in the improvement of plant fitness
4. Significance of bacteria in the rhizosphere
  - Nitrogen Fixation: Symbiotic and non-symbiotic nitrogen fixing forms
  - Phosphate solubilisation: phosphate-solubilizing microorganisms
5. Significance of mycorrhizal fungi
  - Endo- and ectomycorrhizae
  - Mechanisms of mycorrhizal associations: endo- and ectomycorrhizae
  - Effect of mycorrhizal association on nutrient uptake from the soil
  - Mycorrhiza helper bacteria (MHB)
6. Biofertilizers
  - Biofertilizer concept
  - Importance of biofertilizers for sustainable agriculture models
  - Organisms with biofertilizer importance
  - Biofertilizers market: biotechnology and applications.
  - The production of compost as a biofertilizer. Process and organisms involved.

### Recommended reading

1. Smith S. , Read D. (2008) Mycorrhizal Symbiosis, 3rd Edition. Academic Press.
2. Rai M. K. (2006) Handbook of Microbial Biofertilizers. The Haworth Press. Inc.
3. Tilak KVBR, Pal KK, Dey R (2010) Microbes For Sustainable Agriculture. International Publishing House.
4. Deshmukh A. M. , Khoragade R. M. , Dixit, P. P. (2007) Handbook of biofertilizers and biopesticides. Oxford Book Company.
5. Lichtfouse E. (2009) Genetic engineering, biofertilisation, soil quality and organic farming. Lichtfouse, E. (Ed). Springer.

### Teaching and learning methods

Lectures using power point presentations. Lectures notes deposited in the e-learning resources. Laboratory classes: laboratory work and exercises.

### Assessment methods

1. Continuous evaluation - (Regular, Student Worker) (Final)
  - Intermediate Written Test - 20% (The exam includes a practical component. Minimum score of 8.0 val is required)
  - Intermediate Written Test - 20% (The exam includes a practical component. Minimum score of 8.0 val is required)
  - Final Written Exam - 20% (The exam includes a practical component. Minimum score of 8.0 val is required)
  - Work Discussion - 40% (Oral presentation of review works (30%) and field trip (10%))
2. Final evaluation - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100% (The exam includes a practical component. Approved with a grade equal to or greater than 9.5 in 20.)

## Language of instruction

English

## Electronic validation

Anabela Rodrigues Lourenço Martins, Isabel Cristina Sousa Rodrigues, Margarida Maria Pereira Arrobas Rodrigues	Paula Cristina Santos Baptista	Rui Miguel Vaz de Abreu	Paula Cristina Azevedo Rodrigues
18-01-2024	18-01-2024	23-01-2024	23-01-2024